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CONTENTS.

Editorial 373
Government Telephony in England 376
Pike's Peak Polytechnic Society 376
Mails in Chicago Telephone Tunnel 376
Electric Railway Operation in a Great City 376
Some Aspects of Technical Journalism 377
Overhead vs. Underground Mains 378
Method of Charging for Current in Detroit 378
Municipal Lighting Rates in Massachusetts 378
Municipal Ownership in New England 379
Economics of Transmission Problems 379
The Tantalum Lamp 379
Electrical Engineers of the Times.—VIII. C. O. Poole 380
Current News and Notes 380
The Edison Electric Company's System in Southern California—I 383
A Practical Vector Diagram for Induction Motors. By H. C. Specht .. 388
Comparative Voltages: Grounded Transmission Mediums. By J. Stanley Richmond 394
Proposed Central Power Station for Executive Buildings, Washington, D. C. 395
Some Results with Arc Light Carbons 397
The Early Days of American Electric Traction. By Stephen D. Field.. 397
LETTER TO THE EDITORS:
Lighting at Atlanta, Ga. By Georgia Railway & Electric Co. 397
Digest of Current Electrical Literature 397
Book Reviews 401
The Svea Caloric Engine. By G. Emil Hesse 401
Induction Integrating Wattmeters 402
Westinghouse Bi-polar Motors for Direct-Current Circuits 404
Queen Standard Potentiometer 404
Atlas Tapping Machine 405
Steam Turbine Plant in Klondike for Electric Dredges 405
Conduit Bending Machine 405
Industrial and Commercial News 406
General News of the Week 408

TECHNICAL JOURNALISM.

A broad and philosophic paper was read last week before the American Trade Press Association by Mr. Arthur Warren, dealing with the subject of trade journals, particularly from the point of view of the manufacturer buying publicity. It is briefly abstracted elsewhere in this issue. In a sense, Mr. Warren may be said to have made an application to his topic of some very sound principles in engineering, summed up in the principle of securing the best results for the least expenditure of time, energy and money. Mr. Warren pleads earnestly for and believes firmly in the development of a higher type of technical journal than has hitherto been attained. He indicates many of the ways in which the standard may be raised; and it is at least some satisfaction to the management of the ELECTRICAL WORLD AND ENGINEER to know that in some respects it has anticipated him, and that in others it can adopt the suggestions with benefit to its public.

TRACTION IN A GREAT CITY.

There are a great many shrewd and practical points made in the admirable address that Mr. Vreeland delivered last week before the New York Electrical Society, and which was heard with profound interest by a large electrical audience. The attitude taken is not a familiar one to many of us, and when a man with unquestioned right to his opinions says of conditions fairly obvious, "it is beyond belief how often some one or more of them has been overlooked by the electrical engineer," it is evident that merely a superficial consideration of Mr. Vreeland's statements must be helpful to the engineer and expert. If every inventor of electric railway apparatus had had the Vreeland advice or caution "pasted in his hat," a great deal of money would have been saved in the development of the art, and a great deal could be saved to-day. For even now, it is frankly suggested, there is too great change from style to style of machinery, and the new when tested out under all the conditions enumerated by Mr. Vreeland is not always better than the old. And what Mr. Vreeland intimates to the inventor he also applies with equal force to the electrical manufacturer. In short, the keynote of the address is of general application, viz.: that an art or a man is most successful and useful when adjusted to best performance in the environment. Moreover, like the Egyptian monarch of old, Mr. Vreeland, who has been through the drudgery himself, has a great admiration of the man who can turn out the best tale of bricks without any straw. That is a pretty good test of engineering and economic efficiency, though not the only one.

CITY PLANT ESTIMATES.

Reference was made in these columns last week to the data furnished to the Mayor of New York by his engineering committee as to the cost of a plant to do city electric lighting. As we then intimated, the figures, while prepared carefully, did not disclose in any degree the full and real cost to the city of this plant and the operation thereof; and expert central station men have immediately indicated very definitely many of the omissions to which we referred. The points are numerous, some are serious, and at least one or two of them are fatal to the scheme, if it is to be adopted on its merits. For example, aside from the fact that the wiring and fixturing of 175,000 new lamps is not included in the

estimates, every motor now used for any power purpose by the city, anywhere, would have to be changed to utilize the new system, which is entirely different from that worked out and tested out by practice and success, as truly metropolitan by the local lighting companies. Here, then, alone, is an addition of at least 25 per cent. to the estimates submitted.

But this change of system entails an incurable evil. All this great network of the city for lighting of the streets, schools, etc., is left without any reserve of current. Extraordinary as it may seem at this late stage of electrical development, not a single cent is allowed or included for storage batteries. There is no reservoir or reserve supply contemplated, and at any second the whole city network might be, and undoubtedly would be, plunged in darkness. Is this the kind of plant the city wants? Yet if a proper allowance to be made for batteries and the system be adjusted to their use, again a very much higher set of estimates would emerge. There is not one of our readers who does not appreciate the gravity of this criticism, and its validity.

Other points of criticism are made that seem pertinent. One of them is that the true value or cost of the proposed street lighting does not show on the surface, but is obviously much larger after a little consideration of the facts. We can best bring this out by the following quotation: "In all the public buildings, the armories, schools and various departments, the city is now using 75,640 incandescent lamps of the equivalent of 16 candles, which use annually an average of 13.75 kw-hours. On the same basis the annual consumption by 250,000 incandescent lamps would be 3,437,500 kw-hours, which at 5.15 cents a kw-hour would cost only $177,031.25. This change would make very slight difference in the total cost of operating the plant, and therefore if the contention of the engineers that they can make current for 5.15 cents a kw-hour is correct, we must increase the charge against the arc lighting to $728,968.75, which is an average of $121.49 per lamp, again not including lost taxes, real estate and subway costs." If to such figures are added the "lost legions," it is soon apparent that a total cost per arc lamp of over $140 a year is reached, i. e., a cost equal to that of the private companies. It does not seem to us imaginable or possible that the city can want to create a service of its own upon such a basis, for even these figures do not disclose the grim full total of the cost, annoyance and peril to the citizens involved in the adoption of a system liable to be snuffed out in a second and to be interrupted at any time by those whose operations are best carried on with the streets in darkness.

Views of Transatlantic Friends on the A.I.E.E Circular Tour.

A large and interesting souvenir number of our esteemed contemporary, *The Electrical Magazine*, of London, has just reached us. It contains a remarkably full account of the circular tour from England to St. Louis and back, written by one of the party. It also contains expressions of opinion from fifteen members of the British party, which party traveled ten thousand miles in a little more than five weeks. It is pleasing to observe the glad memories that have been left in the minds of our visitors by their American reception, both in the United States and in Canada. All views refer clearly to the recognized efforts made for the pleasure of our guests. There never was a doubt beforehand as to the promise and permanence of the friendship which would be established by the visit, between men of the same line of industry and the same trend of ideals, whose homes lie respectively on the eastern and western sides of the great ocean. Since many of the visitors made on this occasion their first trip to our shores, their views upon the points that particularly struck them on the journey are of particular interest. The salient expressions of remark are both technological and sociological. The sociological views are not seemingly different from those frequently expressed by foreign visitors generally. The technological opinions are, of course, expert opinions, and so far as they are offered, they are not of every-day occurrence, but are peculiar to a class of trained technologists, or engineers. The consensus of expressed comment refers to the large scale upon which industrial undertakings are carried on, the boldness with which they are attempted, the fine capacity for organization frequently displayed in such work, and the rapidity with which valuable improvements are spread and adopted. The uniformity of type in plants and machinery, due to standardization, was also noticed.

The sociological views are of special import from their bearing upon industrial development. The democratic nature of all actions and institutions is specially noticed, with its disadvantages or weak points, as well as its advantages or strong points. Lavish expenditures are noted as the order of the American age, and it is observed that the men in charge of undertakings are remarkably youthful and unconcerned with precedent or preconceived opinions. All of these views are evidently well founded. They refer to conditions that are the logical outcome of the particular environment presented by a relatively young country of large dimensions, inhabited by the more enterprising offshoots from a number of European communities. It is of great importance that the men engaged in industrial development of one country should clearly comprehend the general nature of the conditions that confront their collaborators in other countries, respectively. This mutual understanding not only leads to an enhanced mutual respect, but it also leads to a greater unity of purpose and endeavor.

The problem of supplying electric light, or of electrically transmitting power to communities, is physically and electrically one and the same in all essential respects all the world over, just as there is everywhere but one Ohm's law and one mechanical equivalent of heat. It is the difference of conditions, not only topographical and physical, but also largely legal, traditional and sociological, which changes the problem from place to place, so that the mental attitudes of engineers toward an industrial undertaking are widely different in different countries. A superficial estimate might lead to the error of supposing that the difference in standpoint lay in the men; whereas, to a very large extent, the standpoints are the outcome of the local conditions. We hope that occasions for an interchange of courtesy between electrical engineers of different countries may present themselves at frequent future intervals, for the benefit of visits paid to each in succession, in order to foster the friendliness developed by such gatherings, and also to enable the local conditions in the respective countries to be clearly apprehended by their foreign confrères. The story of the tour is well related in this clever volume of over 150 pages, illustrated by numerous snap-shot photographs and handsome pictures of objective features of interest at the St. Louis Exposition, and en route. A large amount of work must have been entailed in the preparation for publication of the story. The "report" thus afforded deals, however, with the English trip, and it would be very interesting to see something of kindred character from our other visitors, as, for example, those from Italy. They could hardly be expected to take exactly the same view as our English friends, and this continental or Italian survey would be all the more interesting from that very fact.

A NOTABLE TRANSMISSION SYSTEM.

It gives us much pleasure to begin this week a full description of the elaborate system of the Edison Electric Company in Southern California. Not only is the chain of plants constituting it of remarkable interest in itself, but it has been of exceptional importance to the art of power transmission, and of extraordinary usefulness to the territory served. It furnishes to-day light and power over nearly all of the splendid valley that stretches south of the Sierra Madre from Redlands to the sea, and from the Sierras themselves to the southward heights above which towers Mt. San Jacinto. It is a region which has become one of the garden spots of the continent through the enterprise and skill of those who have learned to know its promise. By Nature left with a wholly insufficient water supply and parched from lack of it, the streams of the Sierras turned upon it by man's device have made it blossom as the rose, so that no one who has ever sojourned there can quite escape its witchery. And Nature, too, was niggardly of fuel there. The unwooded plains and bare foothills smoothed as with a Titan's trowel, give small supply above the ground and save for a modest supply of petroleum near Los Angeles there is little below. Until the beginning of power transmission by electricity the main reliance was Australian coal and the cost of power was almost prohibitive. Power transmission on the Western Continent may be fairly said to have been born in Southern California. The first high-voltage alternating plant in America was the little 10,000-volt station established in San Antonio Cañon in 1892 for lighting Pomona and San Bernardino.

The next year saw the first commercial polyphase plant in the country installed near Redlands, where it still remains, as Mill Creek Power Plant No. 1 of the Edison system, running as smoothly and steadily to-day as when the wheels turned over for the first time more than eleven years ago. If we mistake not, too, this was the first American plant in which big alternators were regularly operated in parallel. But this was only the beginning, followed soon by extensions at higher voltage and then by the great and decisive step of the Edison Company in the completion of the Santa Ana River plant, with its 80-mile transmission at more than 30,000 volts clear into Los Angeles. Like the other this threw down the gauntlet to precedent and has probably had a stronger influence on the progress of power transmission than any other single commercial plant. For it made clear the way to real high-voltage working over long distances which before had been looked at askance save by a few far-seeing enthusiasts. To-day the Edison Company alone is operating seven plants in this territory, four of them hydraulic and three steam, has three more hydraulic plants under way and has covered the valley with more than 600 miles of lines for transmission and distribution. Big further developments are under way along the Kern River 125 miles and more to the northward, so that in the near future a supply of power will be available fully adequate to meet the growth of the need. The system of the Edison Company is one of the three great transmission networks of the world, the other two being those around San Francisco and Salt Lake City, respectively. On these three has been done most of the great pioneering work of the art. And more than any mere perfection of technical details, they have inaugurated a complete system of co-operation between station and station, so that the networks function as homogeneous wholes and not as casual aggregations.

This is the last great step in advance toward complete utilization of the hydraulic resources of the country, of which it is difficult to overestimate the final importance. So long as a region, be it a county or a State, is supplied with electric power by scattered individual plants, each of these is limited in usefulness by its own conditions of demand and its own resources of supply. Just so soon as the separate plants are physically united by a coherent group connected to a common network, the conditions of operation change radically. Each unit can help out the others and receive help from them. With the transmission distances now available the conditions of hydraulic supply become those of the general average. A steady stream can so join with a fluctuating one that the deficiencies of each can be made up and the market of both be supplied. A river in which the minimum of power supply is determined by drowning the wheels at high water can be dynamically joined to a stream which at full flood furnishes an enormous surplus of power, and both thereby can be rendered more valuable. Each plant of the system serves as a virtual reserve for the others, and when the network is properly constituted each set of lines acts in a measure to duplicate the others. The result is greatly increased economy of operation, enhanced safety from interruptions and a far wider and more profitable market. It is in this direction that power transmission is advancing, and while there is plenty of opportunity for large independent enterprises, these in the nature of things can form but a minor part of the total development of the country's hydraulic resources. The great bulk of the unutilized power is to-day to be found in relatively small amounts widely scattered and few of them large enough to form individually the basis for a long and profitable transmission. But the great Western networks have taught the lesson of effective co-operation, and of these the Edison Company in Southern California was the first.

INDUCTION-MOTOR VECTOR DIAGRAMS.

The article by Mr. H. C. Specht, appearing on page 388 of this issue, will interest all engineers who are engaged in alternating-current work generally, and in induction-motor operation in particular. In analyzing the behavior of induction motors, engineers have been accustomed either to perform the work algebraically or partly by algebra and partly by diagrams. The method described in the article here referred to is more comprehensive geometrically, and requires less calculation than any with which we are acquainted. It is a remarkable but well-known fact that in an alternating-current transformer the locus of the vector primary current is a circle at all loads, provided that the magnetic flux induced in the core remains constant; that is, when the secondary induced e.m.f. remains constant. When the e.m.f. impressed on primary terminals remains constant, as distinguished from the secondary impressed e.m.f., then the primary current departs from a strict circular locus by an aberration depending upon the vector drop in the primary winding.

The proposition is, however, enunciated by Mr. Specht that the primary current of an induction motor at different loads has for its locus a circular path. This is not generally known, although he refers to a proof of the proposition given by O. S. Bragstad. It is certainly a remarkable proposition, and it is the key to the proposed new vector diagram. Three co-ordinates are necessary to determine a circle, of which points one may be the center and the two others points on the circumference. Mr. Specht takes the latter from the observed respective current strengths at no load, and at infinite load, or with locked rotor. The center of the circle is then arrived at with algebraic aid. Once the circle of primary current is obtained, the characteristics of the machine are speedily derived with reference thereto, and it is very pretty to see the graphical development follow from the description. Assuming that there is no error in the assumptions, the diagram should prove of great practical value, for it offers very little difficulty to follow or construct. It would be very interesting to have it checked by a series of tests on different machines, and also to ascertain what range of error may be looked for when employing a generator giving a relatively complex form of alternating-current wave.

Governmental Telephony in England.

The announcement is made that the British Postmaster-General has come to an agreement with the National Telephone Company to take over its business and buy its plant as from December 31, 1911. Lord Stanley is congratulated by the London press upon the submission to Parliament of what is considered to be a very good and fair bargain, by which both the taxpayer and the telephone user should do very well. The price to be paid for the business is to be settled by arbitration. All that is to be paid is the fair market value of the plant and works of the company. The purchase is to be on what is called "tramway terms"—that is to say, no payment is to be made in respect of compulsory purchase, good will or past or future profits.

Exceptions are made in regard to the private wire business of the company, which can be carried on without the Postmaster-General's license, and in a very few cases where the company's license has been extended beyond 1911. Three-fourths of the whole purchase money may, at the option of the Government, be paid by way of annuity for a term not exceeding twenty years. The Postmaster-General also retains certain powers enabling him to object to the purchase of any plant unsuitable for the carrying on of the business.

In order to insure the efficiency of the service during the company's continuance in possession it is bound by agreement to allow intercommunication without additional charge between the systems of the Postmaster-General and the company and is precluded from showing favor or preference as between subscribers. While the minimum and maximum rates it is to charge are fixed, if, on complaint and after full inquiry, it is proved that the company is giving inefficient service in any district the Postmaster-General may take over the company's business in that district at once without any payment and good will.

It is impossible to estimate with a great degree of accuracy the price which the Government will have to pay for the telephones. When, in April, 1896, the Post Office took over the trunk lines, the cost was £459,114 ($2,295,570), but the purchase of the whole business is, of course, a much more serious matter, from the fact that the company has a share capital of nearly $22,500,000, with debentures amounting to nearly $20,000,000.

Pike's Peak Polytechnic Society.

This society is composed of civil engineers and surveyors, mining engineers, mechanical engineers, electrical engineers, architects, irrigation and forestry engineers, geologists, assayers, chemists and others who are studying or practicing along technical lines. Its object is the promotion of intercourse, observation and records in technical subjects, by means of periodical meetings, reading of papers, discussions, special investigation into matters of public and technical interest, the publication of such parts of the proceedings as should be deemed expedient, providing the convenience of a library and reading room for its members and the collection of books and periodicals on technical subjects. It is also the intention to secure the services of prominent specialists in various technical branches represented by the society, to lecture before the members of the society and invited guests.

The regular meetings are held on the second Saturday of each month in the society's rooms in Coburn Library on the Colorado College campus. The annual dues for resident members are $5 and for non-resident members, $3. There are at present eighty members in good standing. The following officers will serve for the year 1905: President, William Strieby; vice-presidents, B. H. Bryant, L. E. Curtis, W. F. Douglas; recording secretary, E. A. Sawyer; corresponding secretary, W. D. Waltman; treasurer, Ira A. Miller.

The following are the lectures delivered before the society: November 19, 1904, "Notes on Lightning," Prof. J. C. Shedd; November 26, "The Guanajuato Power Plant," Mr. L. E. Curtis; December 1, "General Subject of Forestry," Prof. W. G. M. Stone; December 10, "The Panama Canal," Prof. J. H. Kerr; December 30, "Chicago's Transportation Problem," Mr. Bion J. Arnold; January 14, 1905, "Underground Waters," discussion led by Mr. E. C. van Diest and Prof. J. H. Kerr; January 28, "The Forestry Movement," Mr. Clyde Leavitt; February 11, "French Architecture, Eighth to Fourteenth Century," Mr. Nicolaas van den Arend.

Mails in Chicago Telephone Tunnel.

It is announced from Washington that a contract has been agreed to between the Post Office Department and the Illinois Telephone Company for carrying the mails through the tunnels of the company from the post office to the various depots in Chicago at the rate of $173,000 a year. The terms have all been agreed to and will be signed as soon as some of the formalities have been complied with by the tunnel company. This will eliminate most of the wagon service, which has cost the Government about $106,000 a year. Some of the mails will have to be carried by wagon, and that it is estimated will cost about $30,000, making the service as contemplated aggregate over $200,000 a year, or almost double what it has cost.

Time saved and small possibility of delay are considered by the post office authorities to be worth the extra cost. Much time has been lost in transferring the mails between stations by wagon and also in making the deliveries from the main office. The installation of tunnel service, together with the pneumatic tubes already in operation, will give Chicago the most up-to-date system in the world.

Electric Railway Operation in a Great City.

At the last meeting of the New York Electrical Society, Mr. Herbert H. Vreeland, president of the New York City Railway Company, delivered an address on "Electric Railway Operation in a Great City." The meeting was held in the assembly room of the Metropolitan Street Railway Association, at Fiftieth Street and Seventh Avenue. President F. J. Sprague made some interesting introductory remarks and after the address by Mr. Vreeland an exhibition was given of the careful manner in which the motormen are trained in the mechanism of the car, the principles of electrical operation, and the quick way of preventing and remedying accidents or interruptions.

Mr. Vreeland, in his remarks, laid stress upon the necessity of the electrical engineer learning the practical conditions which must govern the successful application of his knowledge. An invention, however interesting and wonderful, and whatever may come of it in the end, is going to be of small use to him, if its employment calls for the upsetting and overturning of established conditions with all the waste that that implies. It is for this reason that the first study of an electrical engineer who finds himself in the possession of an idea as to a profitable use that may be made of electrical power, must be the existing conditions of the business to which he believes his idea applicable. The engineer should discern those parts and phases that are permanent and inevitable and those parts or phases that are bound to wear off in the process of natural selection, and address himself directly to the adaptation of expert ideas to the permanent parts without being distracted by those phases of it that are transitory.

The distance between the claim agent and the electrical engineer seems remote until it appears that the engineer's device by its too great intricacy or delicacy of construction in the hands of a low-salaried motorman has involved the company in disastrous accidents. The distance between the electrical engineer and the auditor seems remote until when the engineer's device has been tested and compared, and its economic results have been written down in the auditor's cold figures and submitted to the general manager, the engineer is informed that it costs too much for installment and saves too little in operation. It must not be supposed, therefore, that the utility of an idea or of the machine that embodies it has been fully passed upon even when the operating manager and the master mechanic are satisfied.

Important as an electrical engineer or other expert is in the system of a street railway, his value depends upon his realization of the unity of the system and the effect which his idea, incorporated into an apparatus, is bound to have upon each department of a complicated organization. Of course, he must bear in mind at all times that his machine must go into the hands of a class of men who, however expert they may become in its manipulation, must be recruited in large numbers from those whose physical strength is their chief capacity, there to be subject to continual use under the most disadvantageous conditions that can possibly arise. It must be stowed away where it is out of sight and reach, under the car body and close to the roadway. It must stand not only use, but the hardest sort of abuse, not only from the incompetency of a great

army composed of unskilled labor, in which there will always exist a large percentage of gross dullness, and into which there must always be drawn another large percentage of inexperience, but from adverse weather conditions and from adverse conditions of traffic, and the machine operating under these circumstances, however it may break down, must never be permitted to stand in the way of the car that is coming on.

These conditions, of course, are fairly obvious, but it is beyond belief how often some one or more of them has been overlooked by the electrical engineer. He learns his business generally in some great establishment largely devoted to experiment, where the gross earnings of an ordinary street railroad are written off the books in a single month of fruitless investigation, where he is provided not only amply, but even superfluously, with the tools of his trade, and it is difficult for him to understand when he comes to street railroad work that in the running of a car there is no time for repairs and that no device, however generally useful, can be employed on a street car which, if it falls out of gear, requires the car to be stabled before it can be repaired. He easily forgets that the motorman, however well instructed, is not a machinist; that he must keep his car going without the facility of a machine shop, and that often the most important repairs must be made at dead of night in a dark and narrow pit, with cheap labor and under whatever circumstances the fates may provide.

It is the characteristic weakness of an expert to exaggerate the importance of his line of work to the industry with which he is connected. No established industry can afford to spend more than a certain fixed proportion of its earnings upon improvements and betterments. It must pay its fixed charges, maintain its dividends and store up something in its surplus, and whatever it spends for betterments, whether by the use of what remains after all this has been done or by an issue of new securities, must be done with an eye carefully fixed upon its earning capacity. The expert, whether an electrical engineer or other specialist, is rarely willing to concede this condition of things, and the more absorbed he is in his own line of investigation the more unwilling he becomes to admit that anything else counts. When, therefore, he ascertains that of the all too insufficient sum that can be applied to improved methods some must go in one direction and some in another, and that the amount that is left for him to work on is but a fraction of the insufficient whole, his dismay not infrequently takes the form of a fit. He has been trained, moreover, in institutions where experiment is a part of the business, and when he goes into the service of an established industry or undertakes work for the advantage of such an industry, he is slow to adjust himself to the fact that it has no funds for experiment.

No small part of the discouragement which awaits the specialist as soon as he leaves that occupation in which his specialty is the sole aim and business, to employ his talents and training for the benefit of an industry in which his specialty is merely a feature, arises out of this circumstance, and he must quickly learn the great art of making bricks without straw. He will find his consolation in the fact that that is the only way good bricks are ever made; that the man who can only produce when the conditions of production are perfect rarely produces anything worth while; and that the valuable things of life almost invariably come by easy and natural stages from one good and successful thing to another that is better and more successful, from one valuable improvement to another that is better still, and that the perfect has never been reached, but is always farther on. His opportunity is limited, therefore, not by what has been accomplished, but only by the inevitably insufficient means with which he must work. He has accomplished his greatest triumph when he has adjusted himself to this fact.

"So swift has been the advancement in your science that there always exists the great practical danger of your getting too far ahead, commercially speaking, of the operator. It is no unusual experience for us to buy and install a very expensive electrical device, to discover that it does not work in perfect synchronism with other parts of the machine or with other machinery necessary to be operated with it and to have it said to us, "Nothing ails this new motor; it is a good motor. What you want is a new governor; since we made that motor we have made some other new thing to go along with it; you must get that." And then before this other new thing has been in operation a week still another and still a better thing has been devised or is claimed to be devised. There is great danger of your getting too far ahead of us. This may be all very well for the development of the science, but in a practical sense it is not well for you or for us. If you are going to make money at your profession you must help us make money in our business. You must not forever be postponing the day when income begins to pay for investment. You must not be forever requiring one great investment on top of another until we have paid half a dozen times over for substantially the same service. You must keep the practical phase of every subject closely harmonious with practical conditions."

Some Aspects of Technical Journalism.

A very interesting meeting was held of the American Trade Press Association at the Hardware Club, New York City, on February 17, when Mr. Arthur Warren, manager of publicity for the Allis-Chalmers Company, delivered an address entitled "A Plain Talk on Trade Journals." Mr. Warren is not only well known in the technical world, but has himself been a brilliant and successful newspaper editor, correspondent and contributor. He discussed the technical and trade journal from many standpoints, and many of his utterances and views were strikingly bold and incisive. He outlined the function and responsibility of a manager of publicity, and threw the subject of advertising into a new light from the aspect of the manufacturer, who has to avail himself of trade papers in order to reach the vast field of consumption upon which his business is predicated. Mr. Warren made free to say that there were too many trade papers in the field, and that an ordinary publicity manager would have a hundred copies a week coming to his desk, the mere bulk of which was appalling, and few of which he could actually read. As for special numbers, they simply rained. He learned of forty just before Christmas. Special numbers had become as much a burden to the flesh and the spirit as the Sunday newspaper, whose single issue devastated three acres of forest. "Special number" had become only another name for special pleading for special advertising, and had been overdone. It is constant systematic advertising, not spasmodic, that brings results.

Mr. Warren pointed out the essential differences between advertising a soap or a breakfast food and that of pushing the sales by advertising, of reciprocating engines, steam turbines, dynamos, motors, transformers, converters, controllers. The advertiser of the corset and the pill appeals to the world in the bulk and to an unsophisticated audience. The industrial advertiser did not enjoy this advantage, but addressed his claims to a sophisticated audience, trained and experienced, and technically educated along the lines of the apparatus brought forward; and quite as likely to know as much about the wares advocated as the man advocating them. These facts made a remarkable differentiation, and constituted part of the problem of trade journal advertising. The technical press was none the less an educator, and Mr. Warren remarked that the editors of the best technical and trade papers in America "yield as a body not an inch nor an ell in ability and influence and character to any body of professional men in any part of the world. They make your papers powerful and respected. Publishers, as well as other leaders of enterprise, civil, religious, military, are known by their lieutenants, by the company they keep. If it were not for your editors your advertisers would be fewer. The theory is that advertisers advertise in papers that men wish to read."

Industrial publicity is a new thing, Mr. Warren continued, and there was no metal-working factory to-day that spent money enough on publicity, although it was to be borne in mind that advertising space was only one of the tools of trade of the publicity manager. As to elemental principles in the treatment of advertising, Mr. Warren contended that there should be absolutely no cutting of rates; that advertising business should not be handled through agencies, and that every advertiser should buy and handle his own advertising space, design his own advertisements and realize that a publicity department was as much a necessity as a drafting room or a foundry.

This brought Mr. Warren to the question of circulation, that deep and elusive mystery of the business. He said that circulation had been regarded as "one of the dim gods that men cherish in silence, but the time had come when the veil of the temple must be rent." He then described in detail the canvass that he had recently made of papers in which his concern advertised, requesting definite and specific information as to the figures of circulation. On the whole, the results were gratifying, although there had been instances of

undue reticence. He was glad to note the fact that in the month of January three New York publishers of trade and technical journals —members of the association—were to be found publishing in seven of their journals statements of circulation. He thought that these figures might be carried one point further, namely, in making a distinction between copies printed and copies paid for. Their example at any rate was one which no publisher of good standing could afford to ignore, and the next step was one which he believed all members of that representative body could afford to make.

Mr. Warren brought a most admirable, interesting and suggestive address to a close by discussing the reading matter contained in technical papers, approving the development of the news features and pointing out ways in which even the ordinary write-up could be made succulent and satisfying. It was, however, now impossible that the engineers of any great concern could write all the articles demanded of them, as they would then do little else, and he suggested, as an alternative, that the editors themselves or members of the editorial staff should be allowed to circulate more freely through the shops and factories, making observations at first hand and acquainting themselves for the benefit of their readers with what was going on. Some papers were conservative in this and other respects, but he did not believe that the technical press had yet developed the field of information. "There should be, and there can be a closer touch between the papers and the manufacturers. And that closer touch can be obtained without the loss of any independence on the part of the press. The papers that are not independent, the papers that are partisan and that curry favor, are the papers we don't want. The manufacturing concerns are sources of news. You want technical news and perhaps other kinds of news. But very often, especially in regard to large undertakings, you do not get the information until it has lost its news value. There are reasons for that. Perhaps they will never be entirely overcome, because the manufacturer has not only to guard his own interests, but he has to guard the interest of his customer. When large investments are at stake the persons who are paying the money have the privilege of keeping their own counsel. You, as business men, can understand that clearly enough. And again, when the manufacturer is producing a new invention, he prefers silence until he has protected himself by patents, completed his tests and perhaps made a successful installation or two."

Overhead vs. Underground Mains.

In a paper read before the British Institution of Electrical Engineers, Mr. G. L. Addenbrooke brought forward figures to show that, at 6,000 volts between conductors on a three-phase system, the cost of the overhead conductors is about half that for underground cables. It is stated that the most legitimate objection which can be taken to overhead transmissions is from the æsthetic point of view, but against this should be placed to their credit the fact that they would be the means of abolishing much smoke and dirt and heavy coal traffic on the roadways, they would render brighter, cleaner and more cheerful numberless homes; and, by bringing a convenience of town life into more open districts would be a powerful aid in the important object of repopulating the country. Notwithstanding the obvious advantages, the attitude of the high authorities at the Board of Trade has until recently been so adverse to the use of overhead conductors in England as to amount to a practical prohibition, and this has led to a timidity among engineers in proposing their use and an impression among local authorities and the public that they are dangerous, unsightly and liable to faults. In considering the practical position, supposing that overhead transmission is proposed for England, it pointed out that in many districts little difficulty will be experienced in obtaining way leaves, but it is extremely exasperating to be at the mercy of an occasional cantankerous landlord or set of trustees, and it would greatly facilitate matters if there were in England a set of laws and regulations such as have been made in several other countries giving undertakers the power to obtain such way leaves by a form of compulsory arbitration when it can be shown that the project is of public utility. To show the arrangements and formalities necessary to obtain such rights a translation of the Swiss law relating to electric transmission and a translation of the Italian law and rules on the same subject are appended to the paper. These regulations illustrate the care and supervision exercised in Europe by the authorities in regard to such enterprises.

Method of Charging for Current in Detroit.

Mr. Alex. Dow, of the Detroit Edison Company, has been trying to make clear to the public the basis on which the company's rates are founded. The explanation resulted from the publication of an article based on the company's bills which the recipients of the bills did not understand, causing the cry of "discrimination." Mr. Dow's explanation contains these fundamental facts: The electric company ascertains what is or is to be the maximum regular demand by the consumer on its plant. This maximum may be ascertained by actual measurement of the current for a while, though this is not always necessary. The company proceeds to figure the rate from this basis. On this practically assured demand, measured in units, a charge of 16 cents per unit is made. This, according to Mr. Dow, covers such items in the cost of the plant as cost of machinery, depreciation and insurance and profit on the basic number of units.

Four cents per unit is charged for a continuance of the service over and above the number of basic units. Once the consumer has contributed his share toward the cost and maintenance of the plant, as he does in paying the 16-cent rate, the charge dwindles for this reason: The cost of service, over the same wires and into the same lights, from a plant which has been provided for, as to cost and maintenance, is greatly lessened. The additional cost involved is only that incurred through purchase of fuel, labor and some slight additional depreciation. Therefore, the reduced charge.

"John Smith burns 40 lights one hour each day. Thomas Brown burns 10 lights four hours each day. Forty times one is forty and ten times four is also forty. Therefore, each uses the same number of kilowatt-hours. But it costs less than half as much to serve Brown as to serve Smith. Therefore, we charge less than half as much. If we average the two men we would be overcharging Brown to favor Smith," is one of Mr. Dow's concrete examples.

It is the 16-cent rate which practically determines the size of the consumer's bills. The greater the established steady demand which the company finds the consumer is making on its plant, the larger will be the number of units for which he is charged the 16 cents to pay for his share in the plant, its depreciation and maintenance.

Municipal Lighting Rates in Massachusetts.

Writing to the Portland (Me.) *Express,* Mr. Henry W. Hobbs, discussing the subject of municipal plants, says: "In this connection and in comparison with the local rates of $61.20 for street lights and 9 cents per 12 kw-hours for commercial service, witness the actual results of municipal street lighting in Massachusetts. The table following is devised upon the theory that for all its expenditure the city receives only its street lighting, the cost of which is the difference between the gross operating expenses and the income from commercial or private lighting. The rates to consumers are also given:

Municipality.	Cost of street Lights.	Commercial rates.
Belmont	85.57	16c. net.
Braintree	94.84	12c. meter rented.
Chicopee	117.	11.85c. net.
Concord	73.51	12c. net.
Danvers	68.90	10c. net.
Holyoke	78.24	12-10 cents.
Hudson	76.48	15c. net.
Marblehead	73.82	20-15 cents.
Middleborough	93.58	(midnight) 15c. net.
Peabody	64.03	15-13 cents.
Reading	85.03	13.5c. net.
Taunton	107.56	20c. with dis. of 10 to 50%.
Wakefield	100.24	20c. net.
Westfield	84.16	20.14 cents.

"Only two municipalities furnish lamp renewals free, viz.: Chicopee and Taunton. These figures take no account of the municipal water used at the power house, nor of the taxes lost by the displacement of a private lighting company. No allowance is made for depreciation.

"A study of these figures reveals that the private consumer not only pays for street lights in his tax bill, but makes a further contribution every time he settles for lighting his house or place of business.

"After studying this table, we may again settle down to that equanimity which, for some of us, was rudely disturbed by the aforesaid public-spirited citizen."

Municipal Ownership in New England.

The following remarks are quoted as to municipal plants from an authority in New England:

"From annual reports made to the Massachusetts gas commission by electric light companies in this State it appears that since 1898 the price of street lights has been increased by 14 municipal plants, only six municipal places reducing the price. In comparing the figures for the price of street lighting by privately owned companies in the State of Massachusetts, it is found that during the same period, from 1898 to 1903, the price has increased in only seven cases, and these are nominal increases, and has decreased in 56 cases.

"Of course, if a municipal plant is administrated with absolute integrity and with the same ability that the ordinary electric light company is administrated, and if it is large enough so as to obtain the same economies in operation and administration as are obtained by private electric lighting companies, then the municipality ought to be able to do the work as cheaply as the electric light company can. There is no reason, however, why they should do it any cheaper. Most of the savings shown in municipal operation as compared with a supply by a private corporation neglect to take into consideration the taxes that would be received from the corporations.

"The actual figures of the gas and electric light commissioners show no savings to amount to anything by the towns that have their own plants, and they show most decidedly that the cost to the towns that had their own plants is steadily rising, while the cost to the towns that purchase their lighting from a private corporation is steadily diminisihng."

Economics of Transmission Problems.

In the course of his lecture recently delivered at the Brooklyn Polytechnic Institute, Dr. F. A. C. Perrine, when discussing the relative merits of steam engines and hydraulic turbines as means for obtaining power, stated that at the present time each kilowatt-year of energy developed may be estimated as being equal to the use of twelve tons of coal, and on this basis the water power may be compared with the coal mine. In making any such comparison it must, however, be remembered that while the value of the coal mine is constantly decreasing, as the coal is mined, the value of the water power is constantly increasing with the rising price of coal, and that, when the coal supply of the country is entirely exhausted, the water power will still be in operation with but slightly diminished volume. Unlike the water power, we have not as yet succeeded in utilizing a large proportion of the energy stored in coal. Of the 10,000,000 ft.-pounds of energy stored in each pound of coal, we have so far utilized not more than 33,000 in our steam or gas engines, or about one-third of one per cent.; and yet, strange as it may seem, the steam engine and its boiler are fairly efficient machines, and at the present time leave but few steps to be taken that may be taken in the future.

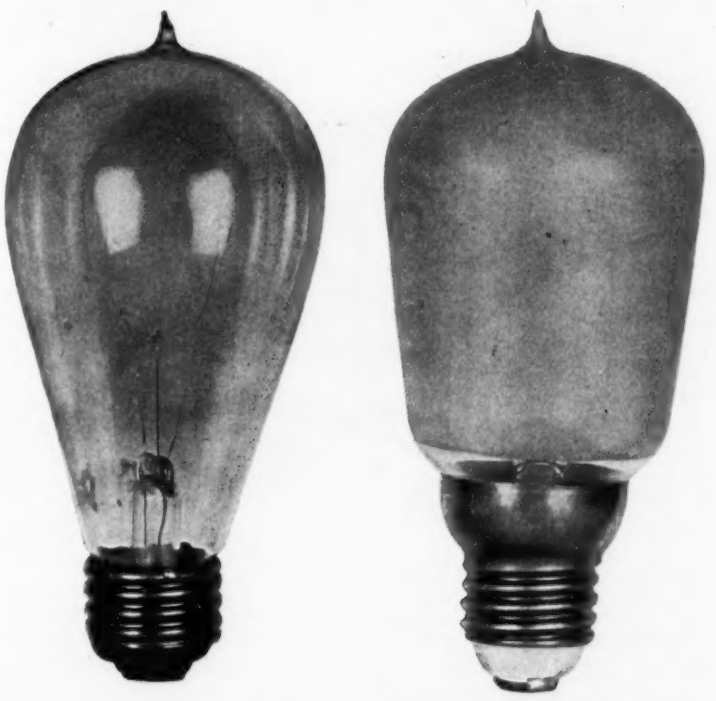
Fuel is frequently obtainable in locations which are not readily connected with a manufacturing market by satisfactory transportation routes. In these locations are included not only the undeveloped mines in remote mountainous regions, but more particularly the mines which are surrounded by those owned or operated by coal-carrying roads or by companies allied to these roads. The present condition of the independent miner, particularly in the anthracite coal field, is a non-competitive one. He is limited to a market in excess of that for which the companies controlling the territory wish to mine from their own properties, and the only possible customer for him is the coal road or the coal company with which he is supposed to be in competition. In consequence, he must either take the price they offer him or leave his coal unsold.

Electrical generation and transmission is a means, under such circumstances, of finding an independent market for the product of the mine, and when such a plan is carried out it is equivalent, for a miner, of an independent road of his own. It may be objected that such a miner is not, even at his delivery point, free from the same competition that he finds about the mine itself; and while this is apparently axiomatic, it is at the same time true that at the delivery point the possible price of coal is determined by circumstances other than those which surround the mine. In dealing directly with the customer for power, the owner of the mine will find many conditions in his favor which are absent in his location from which the coal has been originally obtained. This problem is one for the immediate future. No such undertakings have as yet been attempted, but with the increasing use and advantage of electrical application, the probability of such a plan being carried out and the strong possibility of its commercial success, is every day approaching nearer and nearer.

The Tantalum Lamp.

We give below an illustration of a 22-cp tantalum lamp alongside a 16-cp carbon filament lamp. Owing to the resistance of the filament increasing with the temperature—the reverse being the case with the carbon filament—a given tantalum lamp is adaptable for a considerable range of working voltage. An 118-volt carbon filament lamp has been replaced in this office by a 110-volt tantalum lamp, which thus far has not given any evidence of deterioration. The light given by the lamp is quite white; if a screen is placed between the tantalum lamp and a carbon filament lamp on the same fixture, the illumination on the wall opposite the latter is noticeably yellow in comparison with the illumination from the former.

An account in detail of the new lamp appeared in our issue of



CARBON AND TANTALUM FILAMENT LAMPS.

January 28, including data as to efficiency and behavior during the life of a lamp. By referring to this article, it will be seen that the tantalum lamp has an economy commencing with 1.5 watts per hefner or 1.7 watts per candle-power when new, and decreasing to 1.9 watts per hefner or 2.15 watts per candle-power at 500 hours. The drop in voltage at the end of 500 hours is 20 per cent., which is the usual figure for carbon filament lamps. It is stated that the useful life of the tantalum lamp averages between 400 and 600 hours at 1.9 watts per candle-power. Owing to the increase in the resistance of the filament with increase of temperature, the lamp will withstand temporarily a voltage largely in excess of the rated voltage, and, it is stated, will not blacken when subjected to an overvoltage. The lamp illustrated is frosted except near the base, thus concealing the rather formidable filament-carrying structure, which was shown in the former article.

Municipalism in New Jersey.

A bill has been introduced in the New Jersey Legislature providing for the requirements of electric lighting plants in any city of the State, in case any municipality should desire to acquire such plants.

Electrical Engineers of the Times.—VIII.

C. O. POOLE.

Charles Oscar Poole was born in Saulsbury, near Lowell, Mass., June 17, 1859. When thirteen years old he was taken by his parents to San Francisco, where he received a common school education, which later was supplemented by special courses in mathematics taken at private schools. At the early age of sixteen he entered into practical work in mechanics and mining, which included two years' apprenticeship in a machine shop. When hardly twenty he was engineer of the hoisting and pumping works of a gold mine in Grass Valley, Cal. Soon after he went to the State of Washington to accept employment as engineer, first in the Wilkison and later in the Carbondale coal mines, near Tacoma. Next he was employed at the Seattle mines, near Seattle, as engineer, after which he became an engineer of the steam railway that hauled coal from the mines to Seattle. Subsequently he occupied the triple capacity of captain, engineer and owner of a steamboat which plied the waters of Elliott Bay and later of Lake Washington, Seattle.

When in 1883 the Oregon Improvement Company acquired by purchase the Franklyn coal mines, Mr. Poole was appointed master mechanic of the property with entire charge of its steam and electrical engineering departments, consisting of a steam tramway system, hoists and pumps aggregating a capacity of some 3,000 hp, together with an electric lighting plant. This position he occupied for four years, during which time he came to a realization of the possibilities from the development and application of electricity

C. O. POOLE.

and the important part the new science was destined to play in industry. This conviction was the turning point in Mr. Poole's career and he finally determined upon the relinquishment of the lucrative position which he held to enter the electric lighting field.

The Franklyn mines were using Brush arc lighting apparatus which had been furnished by the California Electric Light Company, of San Francisco—a concern at that time the focus of electrical activity on the Pacific Coast. Proceeding to San Francisco, Mr. Poole promptly secured employment as a dynamo tender in the Brush arc lighting station of the California Electric Light Company—the station which is now known as Station A of the San Francisco Gas & Electric Company. This was in 1887, and within six months he was promoted to the foremanship of the dynamo floor. A year later the repair shop department—a busy department in those days—was placed under his supervision, and next he was made superintendent of the company's arc lighting station on Townsend Street, known as Station B, which contained at that time some 4,000 hp in boilers, engines and generators, and remained for years the largest steam-driven station on the Pacific Coast. This position was held for four years, when Mr. Poole was promoted to the general superintendency of the Edison Light & Power Company, which had in the meantime succeeded to the business of the California Electric Light Company. The responsibilities of this latter position were great, embracing as they did the entire charge and physical management of what was then practically the whole electric lighting and power industry of San Francisco, with the exception of its electric railways. After three years of service in this capacity he resigned the position on February 1, 1900, in order that he might accept the general superintendency of the entire system of the Standard Electric Company, of California, taking charge of its construction and operation, in doing which he followed his matured judgment that long-distance, high-tension power transmission held unlimited possibilities.

When the great plant at Electra was put in operation, it appeared that the engineering portions of Mr. Poole's duties would be lightened, but such was not the case, for work was then begun on the building of a new plant for the Standard Electric Company on the Stanislaus River. The capacity of the installation at Electra is 15,000 hp, while the capacity of the new Stanislaus plant is 21,000 hp, which ultimately may be increased by the building of eight miles of canal to 40,000 hp. Moreover, the United Gas & Electric Company, of which Mr. Poole is a director, had acquired by purchase the business comprising the electrical and gas industries of the city of San Jose and environs, thus completing the chain of electric and gas plants encircling the Bay of San Francisco from the city limits of Oakland to those of San Francisco, a distance of about 100 miles, mostly through a rich and populous community. The power service for the operation of all these districts as well as for the operation of the mines and mills of the Mother Lode in Amador and Calaveras Counties, and the flour milling and other great interests of San Joaquin and Santa Clara Counties, was all under the executive control of Mr. Poole as manager and supervising engineer. During the past two and a half years he has been associated with the Hendrie & Bolthoff Manufacturing Supply Company, of Denver, Colo., and at present, in addition, is engaged as consulting engineer for the Nevada Power & Milling Company, which is installing a 100-mile transmission from Bishop, Cal., to Goldfield, Nev.

Mr. Poole was one of the charter members of the California Electrical Society, of which he was an officer for a number of years, and is a member of the American Institute of Electrical Engineers. Among the subjects of technical papers of his authorship are the location of troubles on arc systems; the application of storage batteries to transmission systems, and the construction of pole lines for extremely high-tension, long-distance transmission work—the two papers last named having been presented before annual conventions of the Pacific Coast Electrical Transmission Association. He also delivered about two years ago a lecture before the graduating class of the University of Colorado on the development of high-tension work in California, which lecture was repeated before the Denver branch of the A. I. E. E.

CURRENT NEWS AND NOTES.

RELATIONS WITH CUSTOMERS.—Interest seems to have been renewed in the paper entitled "Tactful Relations with Customers," read by Mr. John W. Ferguson at the twenty-sixth convention of the National Electric Light Association. The paper had a very wide circulation at the time, thousands of copies being purchased for distribution among employees of different companies. Fresh demands are now being made for the paper, which is one of the most practical in its line ever published.

MARCONI'S MARRIAGE.—A cable dispatch from Bologna, Italy, of February 18 says: "The official notification of the intended marriage of Mr. William Marconi to the Hon. Beatrice O'Brien, sister of Lord Inchiquin, has been made at the municipal offices here. The ceremony must take place within eight days." It has been published in London that Mr. Marconi will bring his bride to America for six weeks and that afterward Mr. and Mrs. Marconi will reside in Italy. Bologna is Mr. Marconi's native place.

TELEGRAPHERS IN RUSSIA.—A cable dispatch from Moscow of February 18 says: "The telegraph operators of the Moscow-Riasan Railroad have struck, demanding a minimum wage of $20 and an eight-hour instead of a twelve-hour day. The telegraph operators of the Moscow-Windau road have also walked out, forcing a suspension of the train service. At Vorenezh the telegraph operators and other employees of the Southwestern Railroad and 3,000 men employed in the railroad workshops have struck for an increase of wages and shorter hours."

SAD NEWS FROM HAMILTON.—A special dispatch from Hamilton, Ohio, of February 9 says: "A large deficit is staring the city in the face as a result of owning its own gas and electric light plant. The public funds have been drawn upon continually to meet expenses."

ELECTRICAL ASSOCIATION OF NORTH DAKOTA.—The Electrical Association of North Dakota is endeavoring, with the co-operation of the Underwriters, to secure the passage of a bill which will establish a legal code of rules and regulations for the installation of electric light and power wiring.

WIRELESS AT SCHENECTADY.—The General Electric Company's wireless telegraph service between Schenectady and Lynn was placed in regular operation the present week. It was found that messages could be received at Schenectady from ships at sea, the messages being intended for the Marconi station at Cape Cod.

IOWA TELEPHONE ASSOCIATION.—The ninth annual meeting of the Iowa Telephone Association will be held at the Chamberlain Hotel at Des Moines March 14, 15, 16. The meeting of the association will be held in one of the private dining-rooms on the parlor floor. Telephone manufacturers and supply men will have their exhibits on the fourth floor. The association banquet will be held Wednesday night, March 15. Mr. Charles C. Deering, Boone, Iowa, is secretary.

YOKED WITH UNBELIEVERS.—Religious objections have been raised against every one of the modern improvements, including the telegraph and the electric light. Now a farmer out at Orrville, Ohio, objects to the telephone. He belongs to the Mennonites and holds that the Lord never intended that people should use the telephone. He bases his belief upon Paul's saying, "Be ye not unequally yoked together with unbelievers." What he needs, evidently, is a selective system.

CITY OF MEXICO IN DARKNESS.—Dispatches from the City of Mexico report the partial destruction of the old Siemens-Halske plant, now the property of the Mexican Light & Power Company, which supplies the city with light. The loss is estimated at $1,400,000. The works had recently been taken over by the Mexican company of which Mr. F. S. Pearson is the consulting engineer, and which is building a 45,000-hp hydro-electric plant about 100 miles from Mexico City. The officers of this company had just arrived in the City of Mexico from Montreal on a visit of inspection.

A NEW COMMERCIAL CABLE.—In regard to the report that the Commercial Cable Company will lay a fifth Atlantic cable, Mr. Clarence H. Mackay says: "The officers of the company have for some time past been engaged on the work of preparing the plans, laying out the route and completing the specifications. The bids for the manufacture and laying have just come in. The cable will be one of high speed and of the latest improved type and great carrying capacity, and will be laid and put in operation during the coming summer. The growth of our business and the rapid service demanded by the public have rendered necessary the laying of a fifth cable. We think our patrons and the public generally will be pleased to see that the Commercial Cable Company is continuing its progressive policy and is fully alive to the requirements of the increasing business. This additional Atlantic cable, we believe, will give the public all the facilities required for some time to come. The entire cost has already been furnished to the Commercial Cable Company by the Mackay Companies because we desire to keep our reserve fund intact." With the laying of another Atlantic cable the Commercial Cable Company is about to increase its already large facilities. It now has four cables between this country and Waterville Island, including the Azores cable, which was laid in 1900. The company has a traffic arrangement also with the German-American Cable Company. It also controls the Commercial Pacific Cable Company, which has the line between San Francisco, Honolulu and points in the Orient. This news is significant in that it serves to show that the cable business has not been seriously affected by the announcement of the possible extensive installation of wireless telegraphy, and that it is yet held that in any event there will be fields of operation for both systems.

NEW TELESCOPE AT HARVARD.—Harvard's astronomical observatory is mounting a 60-in. telescope which will be the largest of its kind in actual use. The instrument was purchased from the estate of Dr. A. A. Common, of England, where it was successfully used by him for private observation. Though smaller by twelve inches than Lord Rosse's telescope at Parsontown, England, it is more modern and much better suited for photographic purposes, of which the university makes such valuable use. The instrument is being installed in a small two-story house. It will be the only telescope controlled and operated entirely by electricity, and the observer can carry on his investigations in the coldest weather, unexposed.

THE VOLUNTEER ENGINEERS.—The First Regiment U. S. Volunteer Engineers held its annual reunion and dinner at the Hotel St. Regis, New York, on Saturday, February 18, Brigadier-General Eugene Griffin, colonel of the regiment in service, presiding. The colors of the regiment and a Spanish flag captured in Porto Rico hung on the walls and a most delightful evening was spent, full of reminiscence, pathetic and humorous, of the stirring events of 1898. Dr. Seaman contributed a most interesting account of his recent experiences at the front in Manchuria, praising highly the sanitation work of the Japanese and insisting on its marvelous results. The guests of the mess were Messrs. John Thomson and T. C. Martin and Capt. "Jack" Stanton. The association is to have a special dinner in Washington at an early date.

TRADE-MARK LEGISLATION.—Mr. Philip T. Dodge, chairman of the Committee on Patents of the National Association of Manufacturers, says in regard to the trade-mark bill now before Congress: "Under this bill the honest manufacturers of America will be afforded a right of property and security in trade-marks not heretofore enjoyed, and they will be enabled by speedy and comparatively inexpensive procedure to prevent infringement. Whatever individual views there may be as to the need of additional legislation, there can be no doubt that the bill is a vast improvement on the existing law, and quite sufficient to accomplish the principal results desired. "The principal advantages of the present bill lie, first, in the fact that it provides for federal registration, not only of trade-marks used in foreign commerce and with Indian tribes, but also of marks used in interstate commerce; second, in that it confers jurisdiction in all cases of infringement of registered marks on the federal courts; third, in that it provides for an appeal from an adverse decision of the Commissioner of Patents to the Court of Appeals of the District of Columbia, thus insuring uniformity of practice and a careful judicial determination of the various questions which may arise; fourth, in that it provides for the registration of certain classes of marks, consisting of proper and geographical names, which have been in use for a term of years and which are commercially recognized; and fifth, in that it provides definitely a procedure for recovery against wanton infringers.

WHEN SNOWBOUND, TELEPHONE.—The Chicago express, on the Erie Railroad, westbound, had a hard experience last Friday between Buffalo and Jamestown. The train encountered the most severe snowstorm of recent years in Western New York. It took six hours to reach Eden Centre, a village twenty-five miles from Buffalo, where it became stalled in huge snowdrifts, some of which had filled cuts to a depth of more than 20 ft. The unique feature of this snowbound train was the installation of a telephone. "In all my experience in railroading I never saw anything like it," said Mr. Turney, conductor of the Pullman section of the train. "The snow was so deep it was impossible for passengers to leave the train. As a joke some one suggested that he would telephone home for something to eat. The suggestion was overheard by a telephone expert on board and he left the train, found a lineman in the village and within two hours a connection had been made. A telephone instrument was set up in one of the Pullman cars and passengers were waiting their turn to talk with friends from ten to two hundred miles away. The train remained in this drift for fifteen hours, and the telephone service being such an innovation every passenger wanted to use it. The instrument was connected with the Home Telephone Company, of Jamestown, and the Frontier Telephone Company, of Buffalo, thus reaching over long-distance independent lines. You could talk from that car as distinctly as you could from your office. I tell you it was great."

A STRIKE IN PARIS.—A cable dispatch from Paris, France, of February 11 says: "In the strike at the electric works the employees are hesitating as to the acceptance of the proposals of the Edison company. There are threats of placing the city in darkness. All the company's buildings and the conduits are being strictly watched."

PREPARING A WAY OUT.—A bill pending in the Indiana Legislature provides for the sale of municipal light and water plants in case cities desire to rid themselves of such encumbrances. It is for the benefit of cities that have tried the experiment of ownership and operation of such plants and, judging from the number of city representatives advocating the bill, one would assume that municipal ownership had proven a very decided failure in Indiana as a whole.

ELECTRIC TRACTION INCREASES STEAM ROAD FARES.—In an address of President Potter, of the Long Island Railway, to a meeting of commuters held to protest against an increase in railroad fares, he intimated that among the reasons for the increase was the competition of electric railways. No steam railroad in existence, he said, could successfully compete with the electric railway, and added that much of the traffic of his road had been diverted by electric lines.

WIRELESS TELEGRAPHY IN CUBA.—A dispatch from Havana states that the Government of Cuba has granted a concession to the Berlin Wireless Telegraph Company for the establishment of two stations on the Telefunken system. One is to be erected at Havana and the other on the Island of Pines. The Cuban Government desires to make experiments with these stations in order to decide whether wireless telegraphy shall be introducd as a means of communication in that country.

TO PRESERVE NIAGARA.—The suggestion that the State place an annual tax upon the use of water from Niagara Falls for power purposes has prompted Mr. Palmer to introduce in the New York Legislature a resolution denouncing schemes to divert the waters of Niagara Falls for power purposes to an extent which would threaten the cataract's grandeur and scenic beauty and suggesting that the Legislature memorialize the President and Congress to enter into negotiations for joint action with Great Britain for the preservation of Niagara Falls from further waste and diversion of its waters. The resolution argues that if a tax should be imposed as suggested it would tend to encourage and legalize permanently the policy of despoiling Niagara Falls.

WINDING FOR CONTINUOUS-CURRENT ARMATURES.—In order to reduce the sparking which takes place at the brushes of continuous-current dynamos caused by the induction incidental to the commutation of the current under the brushes—that is to say, the sparking due to the energy required to divert the flow in a very short interval of time from one section of the armature winding to its neighbor—C. A. Parsons, according to a patent issued February 14, 1905, would wind the armature with a conductor of thin flat cross-section and formed of insulated strands having a lay of one complete turn, or two or more complete turns, in the length of the core of the armature. The inventor states that he has found that the spiral lay, even in a very widely extended thin and flat conductor, prevents all tendency to local currents in the copper. It is not immediately apparent why this special form of winding should reduce the inductance of the conductor as a whole, or decrease the sparking due thereto.

THE ODOR OF SHELLAC.—In the course of his graceful speech at the Institute traction dinner, Mr. Leo Daft remarked: "Eternal vigilance is said to be the price of liberty, and it might be said with equal truth that it was the price of operation. To the anxious pioneer life was full of tribulation, the constant cry was for armatures when there were no armatures, breakdowns were of such frequent occurrence that the very idea of rest was a mockery, a delusion and a snare. Every ring of the telephone, which was only just out of its own swaddling clothes, announced some new difficulty to be surmounted or some tale of woe, and the engineer in charge of present-day equipments, with armatures capable of encircling the globe without repair, will smile to learn that the report of an armature having completed its twelve hundred miles without going into the repair shop enabled the speaker to pass at least one night of blissful repose. Many of the older ones here will well understand the statement that the odor of asafœtida was in those days as the balm of a thousand flowers compared with that of burning shellac."

ELECTRICITY ON THE ELEVATED.—Mr. L. B. Stillwell, at the recent Institute traction dinner, said in regard to the Manhattan Elevated system: "Electrification of the elevated lines in New York has increased their capacity by one-third, and has decreased by one-fifth the time spent on trains by the average passenger. It has been demonstrated that the cost of maintenance of electrical equipment of rolling stock is materially less than steam equipment. It has proved that electricity can render more reliable service than steam, the aggregate delays due to all causes on the Manhattan lines now being less than one-half per car mile what they were when steam was used as a motive power. It has eliminated smoke, steam and cinders, formerly the cause of so much annoyance to abutting property owners and to people passing beneath the structure, and it has secured financial results eminently satisfactory to the stockholders of the Manhattan Company. The combined system now controlled by the Interborough Company is operating electrically more than 250,000 car miles per day, which, I believe, is about four times the passenger car mileage of the New York Central system."

REPORT ON BROOKLYN RAPID TRANSIT.—The New York State Railroad Commission has made public the report on Brooklyn transit conditions concerning which the commission recently gave several hearings. The report practically covers every Brooklyn route, with recommendations for more frequent service on the surface lines and longer and more frequent trains on the elevated divisions, and the Brooklyn Rapid Transit Company is requested to signify within ten days whether it will comply. The board does not approve the Neils Poulson plan for a Brooklyn Bridge terminal. It urges that several tunnels be built between the boroughs and that the Brooklyn and Williamsburg Bridges be connected by an elevated structure. The board, while "not unmindful of the law," recommends that the Brooklyn Heights Company construct an additional track on all its elevated lines, this additional service to be cared for at bridge terminals. The same company is urged to hurry the lengthening of elevated station platforms previously recommended. Among lesser items the report recommends that the removal of ashes should be carried on only at night, and that the ash cars be not so heavy as at present.

GOVERNMENT TELEGRAPH WORK.—At the recent annual dinner of the American Institute of Electrical Engineers, Gen. A. W. Greely said: "From 1898 up to this time I have had no disposition to lay thousands of miles of cable or build up several systems of wireless telegraph, but as from day to day the duty came to me I have done it. It has been my fortune within the last six or eight years for strictly military uses to lay a series of submarine cables, land lines and wireless systems, and, thank God! they are all American from beginning to end—they would reach around the world; and there has been laid under my direction within the past year in Alaska a cable long enough to reach from Newfoundland to Ireland; and there is to-day working across Norton Sound a system of wireless telegraph that is in its seventh month,and has worked over the 107 miles without a moment of interruption, and over which system thousands of words are sent to and fro each day, and on one occasion not less than twenty-five messages passed across this intervening space of 107 miles without there being a call for a 'repeat.' You telegraph men know what kind of service that is. This work has excited a great deal of interest in Alaska on account of our continuing to work during the past winter over the 107 miles of ice. We were told we could work in summer, but that when the winter came we could not work, yet when the winter came we continued the work." General Greely then added some details as to the 1,300 miles of telegraph line put up in Cuba, and the 10,500 miles in the Philippines—all done by the American soldier—a being of resourcefulness, energy and determination to do the best. He justified also the stand that the Government had taken in regard to doing its own wireless work, on the ground that the companies undertaking it had not found themselves able to live up to their contracts.

The Edison Electric Company's System in Southern California.—I.

TO Southern California belongs the distinction of having the first commercial polyphase transmission system installed and operated in the United States. Continuously since the installation at Redlands of this pioneer system some eleven years ago, the development of water power plants and the building of high-tension transmission lines have been vigorously and successfully carried on in that part of the country, the work being always up to the best prevailing standards, and in many instances setting the pace for other plants all over the land. By far the most important power company in Southern California is the Edison Electric Company, which has its headquarters in Los Angeles, and is operating or carrying on its development work in seven counties. The company has an extensive system, embracing four water and three steam stations now supplying power, three water power plants nearing completion, with seven more projected, and 600 miles of transmission and distributing lines, which supply current for light and power purposes to over 20 cities and towns, as shown on the map, Fig. 1. As to its history, the Edison Company had its small beginning with the West Side Lighting Company, which was organized in 1896 to compete in Los Angeles with an established company. In 1898 the Edison Company acquired the property of the Southern California Power Company, which then controlled the Redlands-Mill Creek and the Santa Ana plants. In succeeding years occurred the acquisition of the Pasadena Electric Light & Power Company, the Santa Ana Gas & Electric Company, the Redlands Electric Light & Power Company, the California Power Company, and the Mountain Power Company. The latest addition to the system was the United Electric, Gas & Power Company, operating in Santa Barbara, Santa Monica, Long Beach and other coast towns.

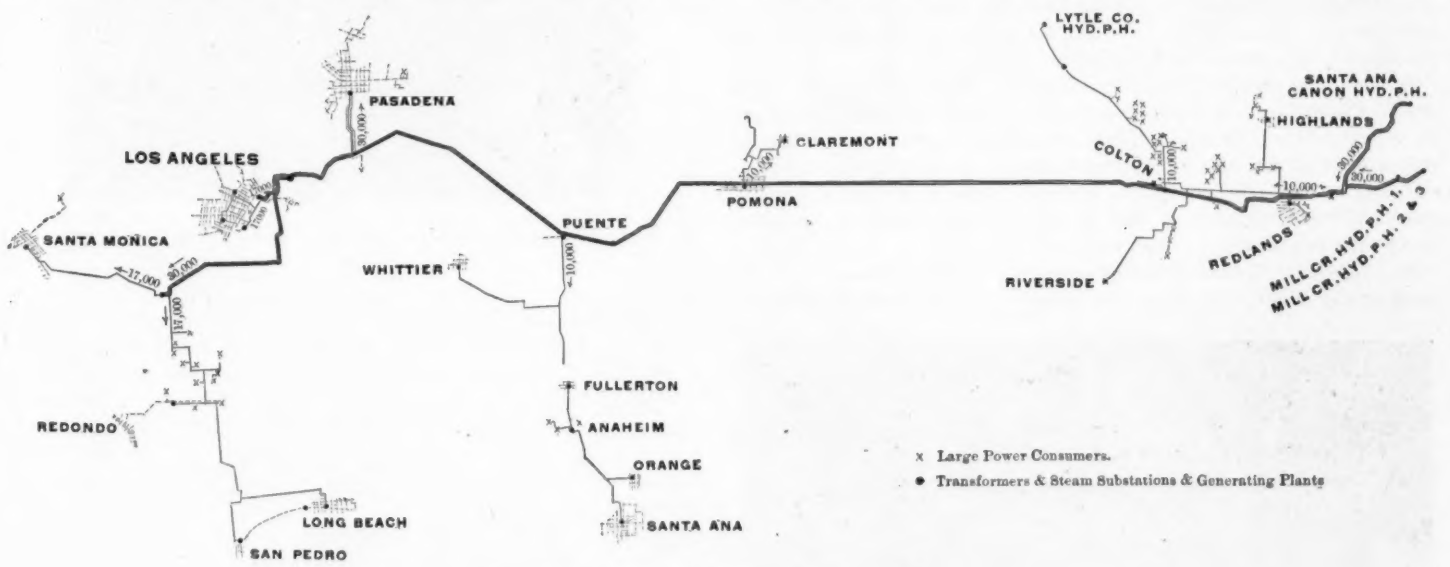


FIG. 1.—GENERAL MAP OF EDISON SYSTEM.

It is the purpose of the present article to describe some of the engineering features, both hydraulic and electrical, which may be taken as characteristic of the development of the system, or which are novel and unusual. Mention will first be made of the general field of hydraulic development which is now covered by the company, and then the different plants will be treated in their natural order. After that the electrical generation and transmission features will be taken up, both of the water and principal steam plants, and this will be followed by notes on the distributing systems, line construction, etc. Practically all the drawings of hydraulic features that accompany the article are of the late plants which are now nearing completion and may be taken as illustrative of the improvement upon the standard construction of similar works installed on earlier plants.

GENERAL FIELD OF HYDRAULIC DEVELOPMENT COVERED BY THE EDISON ELECTRIC COMPANY.

The territory within which the Edison Electric Company has been developing its hydraulic plants, and still continues to do so, extends from the Kern River, in Kern County, on the north, to the Santa Ana River, in San Bernardino County, on the south. The streams upon which power plants are already constructed, or are in course of construction, are all of the leading rivers and creeks flowing down the westerly slope of the Sierra Nevada Mountains and the Sierra Madre Mountains between the limits above stated. Beginning with the most important of these streams, they are enumerated as follows: Kern River, flowing through Tulare and Kern Counties; Santa Ana River, Mill Creek and Lytle Creek, all situated in the County of San Bernardino.

The Kern River is by far the largest and most important of these streams, but as the work there is only in the construction stages, mention will first be made of the San Bernardino County streams, where the Edison Company began its hydraulic power developments, and where much of the pioneer hydro-electric work of the West has been done. The Santa Ana River and its water powers will first be considered.

GENERAL DESCRIPTION OF THE SANTA ANA RIVER.

The watershed of the Santa Ana River is approximately 172 square miles in area. The flow of the stream ranges from 20 cu. ft. per second minimum to as high as 1,000 cu. ft. per second during floods. The ordinary summer flow of the stream may be stated at about 40 second-feet, while the average throughout an ordinary year, which can be devoted to power purposes, would be about 60 second-feet. On Bear Creek, a tributary of the Santa Ana River, which enters the stream at the intake of the Edison Company's power plant No. 1, is located the Bear Valley reservoir. This reservoir, which is formed by the now famous Bear Valley dam, has a capacity of nine and three-quarters billion gallons of water, and serves to equalize the flow of the stream throughout the year. In this way the high floods and extremes of low water which obtain on the other streams are avoided, and the output of power is quite uniform throughout the season.

SANTA ANA RIVER PLANT NO. 1.

The intake of the Santa Ana River plant No. 1 is at the junction of Bear Creek and Santa Ana River. The power house is situated three or four miles farther down, near the junction of the river and Keller Creek. The plant was completed in the year 1898 and has been in continuous operation ever since that time, being the first hydraulic power plant constructed by the Edison Electric Company, and one which is antedated only by the Mill Creek No. 1 plant, which was originally constructed by the Redlands Electric Light & Power Company and later passed to the possession of the Edison Company.

The diversion of the water at the headworks is made by means of two flumes—one on Santa Ana River and one on Bear Creek—which unite in a tunnel known as Tunnel No. 1. At the mouth of this intake tunnel has been erected a rock shed for protecting a gate in the flume. From that point down the conduit consists of eighteen tunnels, which are driven through the various spurs along the mountain side. Between these tunnels are a number of flumes which span the various canyons intervening. The lengths of the tunnels are as follows:

Tunnel No. 1	220 feet
Tunnel No. 2	460 feet
Tunnel No. 3	700 feet
Tunnel No. 4	530 feet
Tunnels No. 5 and 6, which have been united by a cemented arch, have a combined length of	900 feet
Tunnel No. 7	900 feet
Tunnel No. 8	2070 feet
Tunnel No. 9	730 feet
Tunnel No. 10	850 feet
Tunnel No. 11	700 feet
Tunnel No. 12	840 feet
Tunnel No. 13	210 feet
Tunnel No. 14	540 feet
Tunnel No. 15	220 feet
Tunnel No. 16	780 feet
Tunnel No. 17	560 feet
Tunnel No. 18	830 feet
Being a total length of tunnel of	12,040 feet

The dimensions of these tunnels are as follows: Net inside width, 4.5 ft.; depth of water-carrying cross-section, 6.5 ft.; distance from water-carrying cross-section to top of arch, 2.1 ft. The carrying capacity of the tunnels is 120 second-feet of water, which will produce at the power station about 6,000 hp. In other words, a miner's inch of water will produce a horse-power. The capacity of the flumes on the line is the same as that of the tunnels.

In addition to the line of tunnels and flumes above described, the hydraulic equipment of this station includes a sandbox, constructed substantially of redwood timber on concrete piers, for the purpose of precipitating sediment carried by the water. This sandbox has two parallel hoppers, with sluice gates in the bottom through which the silt is expelled into the canyon below. The sluicing of the sandbox can be executed while the plant is in operation, as the water will pass through one hopper while the other is being emptied. Fig. 2 is a view of the sandbox, showing the automatic leaf rake, which is operated by a small water wheel in the tunnel below.

At the lower end of the gravity conduit is a concrete forebay from which a steel-riveted force main, 30 in. inside diameter, leads to the power house. Provision is also made for another force main of the same size, and this is now in course of construction, a considerable portion of the pipe for it being already on the ground. The length of the force main is 2,210 ft., and the total fall from the forebay to the power house is 728 ft.

An ingenious home-made float gauge has been arranged at the head of the Santa Ana River No. 1 pressure pipe to indicate at the

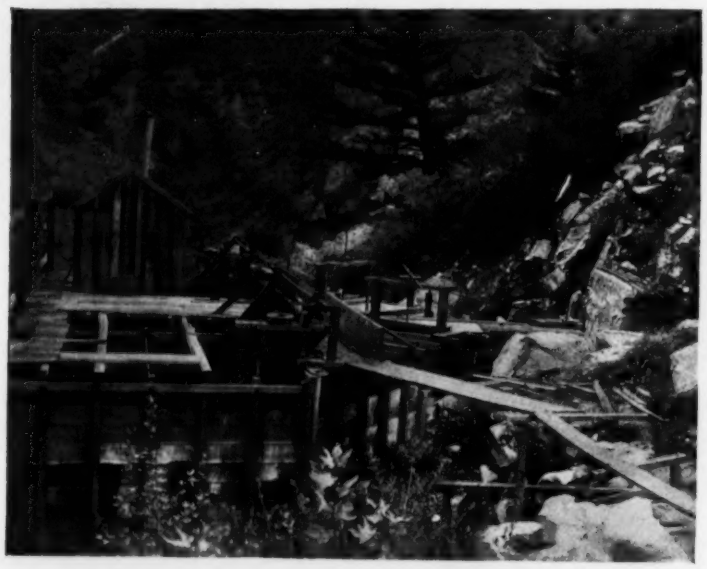


FIG. 2.—SANDBOX, SHOWING AUTOMATIC LEAF RAKE.

power house the height of water in the forebay above. The arrangement is illustrated in Fig. 3. A bicycle wheel minus the rubber tire has been mounted on a horizontal axle and a rope passed around its rim one and a half turns. On one end of the rope is a float in a standpipe, in which the water stands at the level of water in the forebay. A weight at the other end of the rope hangs free and serves as a counterbalance. The raising and lowering of the float due to variation in the water level turn the wheel to which is rigidly connected the resistance arm of a rheostat mounted behind the wheel. The rheostat is connected in circuit with a voltmeter on the switchboard at the station, and the voltage varies directly with the resistance. The dial of the instrument is calibrated in inches of water, so that the station operator can tell instantly how much water there is in the flume above, and can regulate his wheels and nozzles accordingly.

The water at the head of the pressure pipe can be shut off when necessary by means of a boiler plate gate moving in brass slides. This gate is operated by a hydraulic ram by means of oil pressure. Crude oil is pumped into the ram by means of a hand pump, the oil being taken from a small tank under the pump. The ram and gate are then moved by throwing the hand lever.

SANTA ANA RIVER PLANT NO. 2.

Power plant No. 2, situated in Santa Ana Canyon, diverts its water from the tail-race of power plant No. 1, and will deliver it

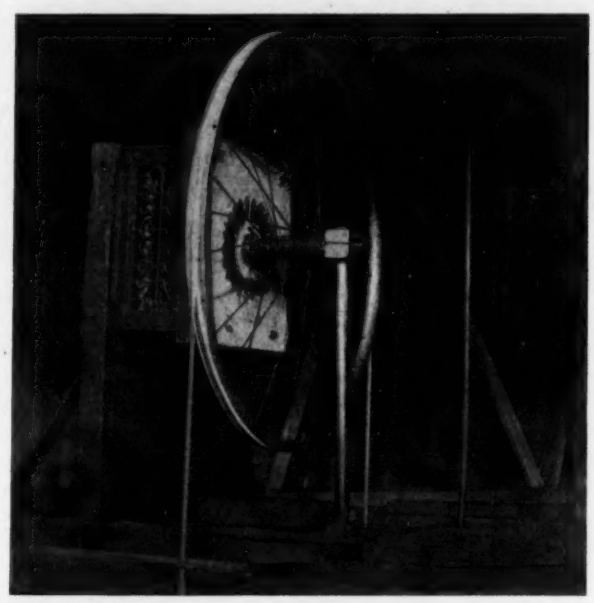


FIG. 3.—FLOAT GAUGE AT HEAD OF SANTA ANA RIVER. NO. 1 PRESSURE PIPE.

to a power house located about two miles further down stream at the head, to what is known as the "Old Santa Ana Canal."

The first structure consists of a settling chamber at the end of the 300-ft. tail-race at Station No. 1, from which runs a 40-in. steel pipe under the bed of the Santa Ana River, in the form of an inverted syphon, 440 ft. long, to the opposite side of the canyon. Along that side of the canyon has been driven a line of tunnels, consisting of eleven separate tunnels, aggregating in length 7,517.46 ft. This covers the entire line of the conduit except an inverted syphon across what is known as Dirt Canyon, a flat ravine that cannot be crossed except by a high trestle or an inverted syphon; the latter form was adopted as being preferable. This syphon will consist of a double line of steel pipe, 44 in. inside diameter, each line being of a length of 377.94 ft.

The length of each of the tunnels on Santa Ana River No. 2 is given in the following table:

Tunnel No. 1	267.26 feet
Tunnel No. 2	270.42 feet
Tunnel No. 3	523.01 feet
Tunnel No. 4	425.11 feet
Tunnel No. 5	179.20 feet
Tunnel No. 6	429.97 feet
Tunnel No. 7	422.69 feet
Tunnel No. 8	1822.59 feet
Tunnel No. 9	1419.30 feet
Tunnel No. 10	1456.30 feet
Tunnel No. 11	301.61 feet
Being a total length of tunnel of	7517.46 feet

These tunnels are 4½ ft. wide inside of the concrete work, and have a depth at the water-carrying cross-section of 5 ft. The tunnels are concreted throughout, both sides and bottom, and plastered with a smooth coat of cement plaster. Wherever the formation overhead is not of continuous rock, the tunnels are arched with concrete above the water-carrying cross-section. The carrying capacity of these tunnels, and syphons as well, is 100 second-feet of water.

In addition to the main conduit there are two subsidiary syphons, which deliver the waters of the two tributaries on the opposite side of the stream into the conduit. These tributaries are known as Keller Creek and Alder Creek, and the syphons are known by the same names. These two lateral inverted syphons cross the main channel of the Santa Ana River from the north to the south side

and are of the following lengths: Keller Creek syphon, or pipe line, which is of steel-riveted pipe, about 10 in. inside diameter, has a length of 895.1 ft.; Alder Creek syphon, or pipe line, which also consists of riveted steel pipe, 10 in. inside diameter, has a length of 857.43 ft.

The inlet chamber at the end of the tail-race of No. 1 plant and the upper end of syphon No. 1 is 25 ft. square on the inside and 5 ft. 7¼ in. deep with 6-in. concrete floor and 12-in. walls. A gate is placed in one corner of the chamber and at the end of the tail-race, which is 5 ft. 6 in. wide and 4 ft. 7¼ in. deep. The gate is raised by two cast-iron racks spaced 3 ft. 5 in. apart, playing into two pinions mounted on a 3-in. shaft, which in turn is driven by two sets of spur gears from a 12-in. hand crank. The discharge from the inlet chamber is through a 44-in. pipe tapered to 40 in. at a distance of 10 ft. and set at an angle of about 30° with the chamber wall.

At the lower end of syphon No. 1 is constructed a sandbox, Fig. 4, 30 ft. long and 18 ft. 6 in. wide, and having two hoppers or compartments, through which the water must pass before entering the line of tunnels. This sandbox is provided with 12-in. sluice gates for sluicing out the sediment which collects, and is so arranged that the water may be passed through one side, or hopper, while the other is being emptied. The sandbox, as well as the lower end of Syphon No. 1, is located between Tunnels Nos. 1 and 2. Tunnel No. 1 is used only for diverting water directly from the stream, in the event of more water being desired for the plant than is at any time being carried through power plant No. 1. The sandbox is so arranged that water being diverted directly from the stream through Tunnel

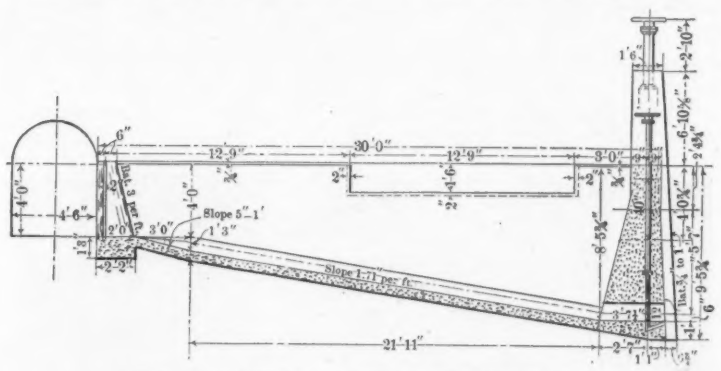


FIG. 4.—SANDBOX AT END OF SIPHON NO. 1.

No. 1 can be passed through the sandbox and relieved of its sediment before flowing down the tunnels.

At the lower end of Tunnel No. 11 is constructed a large forebay, which brings the water to absolute rest before it enters the force main. In this way any droppings from the roof of the tunnel or sediment which might pass the sandbox at the headworks on a flood, are deposited, and can be sluiced out without passing through the force main.

The pressure main consists of 644.5 linear ft. of 36-in. riveted steel pipe, having a thickness of from No. 10 to No. 0 B. W. G. The force main, as well as all syphons, is provided with air valves, blow-offs and an air chamber at the lower end of the main. A large 36-in. valve is placed in the pipe outside of the power house wall, by means of which the entire flow of water can be shut off at any time. Beyond this gate valve and inside the power station the pressure pipe branches by means of a curved Y, from which the two units in the station are supplied. On the pipes from each branch of this Y are placed gate valves for shutting off the water supply to each unit, so that one may be closed and the other still remain in operation.

The fall of water through the No. 2 force main is 310 ft., which will give an output of power from this plant of somewhat more than three-sevenths of that which is obtained from Santa Ana River plant No. 1.

SANTA ANA RIVER PLANT NO. 3.

Santa Ana River plant No. 3 has not yet been constructed, work having progressed only to the extent of completing tunnel No. 1 and beginning the excavation of tunnel No. 2. The water for this plant will be taken directly from the tail-race of the No. 2 plant and conducted by means of a continuous line of tunnels to the power station located about 1¾ miles down the stream. The line has been located and the right-of-way for the same obtained. A tract of land has been purchased for the power house site and the actual construction of the plant is in progress. The length of this line will be approximately 7,000 ft. of tunnel, and the net fall available for the power station slightly less than 300 ft. The work has not yet progressed sufficiently to give an accurate description of it, but the construction will, in general, be similar to that of Santa Ana River No. 2.

SANTA ANA RIVER PLANT NO. 4.

Power plant No. 4 will have two hydraulic conduits; one from the Santa Ana River, with point of diversion about one mile above Seven Oaks, and the other from Bear Creek, with point of diversion at Corkscrew Falls. The power house site will be at the lower end of "Lost Man's Valley" on Bear Creek, which is a short distance above the intake of Santa Ana River No. 1. The fall available from the Santa Ana River branch will be about 1,000 ft., and from the Bear Creek branch about 2,200 ft. The construction of the plant has already been commenced. On the Santa Ana branch, Tunnel No. 1 has been excavated, and Tunnel No. 2 is about completed. Work on the Bear Creek branch could not be prosecuted until a trail and road had been built to the headworks, as this part of the country was wholly inaccessible before these improvements were made. The two lines of conduit together will carry the same amount of water as the other plants in Santa Ana Canyon, above described. No. 4 plant is being handled by the Union Power Company, which is a sub-corporation jointly owned by the Pacific Light & Power Company and the Edison Electric Company.

DESCRIPTION OF MILL CREEK.

Mill Creek is one of the chief tributaries to the Santa Ana River, but flows through a less rugged canyon. The stream has a watershed of 60 square miles above the mouth of the canyon. The watershed varies in elevation from 3,000 ft. to 12,000 ft. Its exposure is toward the west, and the amount of rainfall received on the watershed is very great. The heavy precipitation causes the stream to send down a very large amount of water for the area of its drainage basin. The average flow for an ordinary year during the irrigating season is from 16 to 20 second-feet, or from 800 to 1,000 miner's inches under a four-inch pressure.

MILL CREEK POWER PLANT NO. 1.

Mill Creek power plant No. 1 was constructed by the Redlands Electric Light & Power Company in the year 1893. As originally built, the plant consisted of a 30-in. steel force main, which took the water directly from the stream and delivered it to the power house under a head of 377 ft. In the year 1896 the force main was extended up stream to the mouth of the canyon, adding 3,000 ft. of pipe, and delivering the water under an increased pressure, making the total head 530 ft. The pipe ranges from No. 12 B. W. G. to 5/16 in. thickness at the lower end. The lower end terminates in a receiver 8 in. in diameter, which was constructed under the old theory of hydraulics relating to power plants. Subsequent experiments have shown that such a receiver is a detriment as it causes a loss of pressure. For this reason all the later plants have been constructed with branches and taper pipe from the end of the force main instead of enlarged receivers. The average output of Mill Creek plant No. 1 is about 1,000 hp. The plant, although in operation for more than eleven years, is in good condition and running as smoothly as when first constructed.

MILL CREEK POWER PLANT NO. 2.

The conduit for Mill Creek plant No. 2 diverts its water from Mill Creek, at the junction of Mountain Home Stream and Mill Creek. It handles only that water which rises in the stream below the intake of No. 3, which is five miles further up stream, and the water of Mountain Home Stream. The line consists of 22-in. concrete pipe, which is laid through a number of tunnels and in trenches excavated along the side of the mountain, and of a number of flumes spanning ravines between the tunnels along the line. The plant was completed in September, 1899, since which time it has been in continuous operation.

The intake consists of a tunnel projected into the gravel wash of Mill Creek and a shaft connecting this tunnel with the surface of the stream, by means of which the surface flow is diverted. The tunnel beneath the gravel bed of the stream draws out the underflow, and adds it to the surface flow. The intake shaft is provided with a screen made of T-rails, and has a movable gate for regulating the flow of water admitted. A concrete dam is constructed across the channel of the stream for turning the surface water into the shaft. Sand which collects above this dam is sluiced out by means of a

sluice gate, while the sand which enters the shaft and tunnel is caught by the sandbox, which is located immediately below this tunnel.

The sandbox is 22 ft. wide by 50 ft. long, and is divided into five compartments by means of concrete walls. The sandbox has a sloping bottom, being 5 ft. deep at the upper side and 9 ft. at the lower. Each of the chambers is V-shaped, so that the sand which collects can easily be expelled through the sluice gate at the lower end of the chamber. The main flume passes along the upper side of the sandbox so that the water may be delivered into any one of the compartments, as desired, or carried entirely past the sandbox into the head of the pipe line. This sandbox has given excellent results, its large sectional area checking the velocity and causing all sediment carried by the water to be deposited before entering the

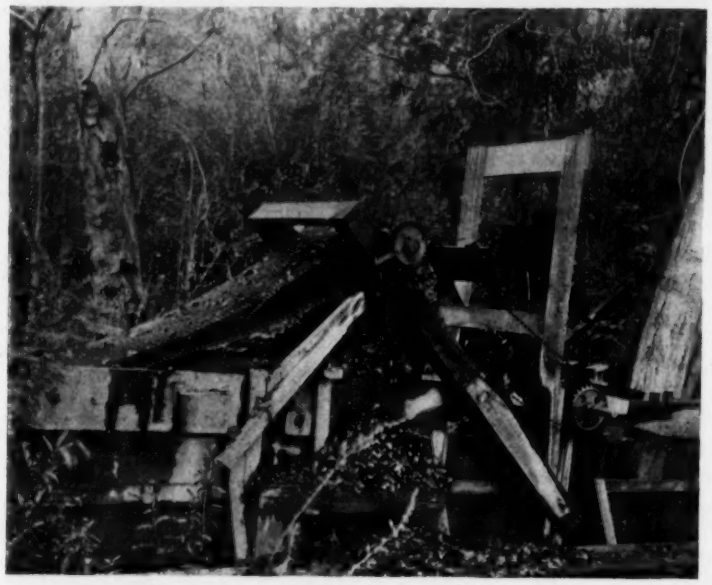


FIG. 5.—AUTOMATIC LEAF SCREEN, NO. 2 MILL CREEK HEADWORKS.

pipe. Fig. 5 illustrates an automatic leaf screen at the headworks, which is driven by an undershot wooden wheel in the flume.

There were originally constructed along the line of power plant No. 2 five tunnels, which are described as follows:

Tunnel No. 1	400 feet in length
Tunnel No. 2	450 feet in length
Tunnel No. 3	450 feet in length
Tunnel No. 4	570 feet in length
Tunnel No. 5	140 feet in length

Since the construction of the plant another tunnel has been added, which is located between Tunnels Nos. 3 and 4. This tunnel is 173 ft. in length, and took the place of a flume which was deemed unsafe, owing to the insecure foundation obtained at that point.

At the lower end of the gravity conduit, consisting of 22-in. concrete pipe and redwood flumes, a forebay 20 ft. in length by 17 ft. in width, inside measurement, with a depth of 10 ft. at the lower end and 5 ft. at the upper end, has been constructed of concrete masonry. The purpose of this is to settle the water before it enters the force main and cause the silt, if any, to deposit before the water enters the pipe. Silt deposited in this manner is expelled by opening a sluice gate in the bottom of the forebay.

The pressure pipe of Mill Creek No. 2 has a length of 1,411 ft. and a total fall of 627 ft. from the forebay to the power house floor. The pipe is 18 in. inside diameter and is what is known as "continuous riveted steel pipe," having a range of thickness of from No. 14 to No. 0 B. W. G. The longitudinal seams are double-riveted and the circular seams single-riveted. To preserve the pipe against rust, it has been double-dipped in asphaltum before being laid. The whole pipe is covered over in a deep trench so that no portion of it is exposed to the sun and elements. To prevent vibrations or sliding of the pipe line, it has been anchored at a number of places with heavy concrete anchors. These anchors are dove-tailed into solid rock at the sides and bottom of the pipe trench so as to preclude any possibility of the pipes slipping. At the lower end of the force main there is located a large cast-steel Y, which branches the line into three different pipes. Two of these are 13 in. inside diameter and lead to the two generators for this plant; the third is a 6-in. pipe, supplying water for the two exciters. The alignment of these branches is by means of long radii, so that no losses of head occur as would be the case were elbows or angles used instead. The force main is supplied with blow-offs, air valves and pressure gauges, and a large standpipe at the upper end for admitting air into the line in the event of the water being shut off suddenly. There is located at the lower end, near the station, an air chamber which will prevent any water hammer on the line even though the velocity be checked suddenly.

The water from the tail-race of the No. 2 and No. 3 plants is carried in a redwood flume, across the channel of Mill Creek No. 1 pipe line. This flume has a sufficient capacity to conduct the combined waters of No. 2 and No. 3 plants. The overflow from the forebay of both pressure mains is carried in a flume of 2-in. redwood plank down to the channel of Mill Creek, from which point it flows into the No. 1 pipe line. The nozzles and tail-races are all located underneath the floor of the station. The stream when deflected from the wheel meets two deflector plates, which reverse it in a direction at right angles to the nozzle and then turn it parallel with the floor of the tail-race in such a manner as to remove all energy from the jet.

MILL CREEK POWER PLANT NO. 3.

Mill Creek No. 3 plant was completed and put into operation during March, 1903. The intake of the plant is located about five miles farther up the stream than the intake of power plant No. 2, at a point known as Akers Narrows, being a contraction of the channel of Mill Creek. The intake is quite similar to that of the No. 2 plant, consisting of a tunnel through the bedrock of the channel; a shaft for delivering the surface flow into this tunnel; an underground drainage tunnel for diverting the underflow; a masonry dam across the channel for diverting the water into the shaft, and screens at the entrance of the shaft, constructed of T-rails and strap iron. Between the intake tunnel, which is known as tunnel No. 1, and the sandbox is a short section of redwood flume, which delivers the water directly from this tunnel into the sandbox.

The sandbox, a view of which is given in Fig. 6, is a concrete masonry structure, 100 ft. in length by 50 ft. in width. It has eight

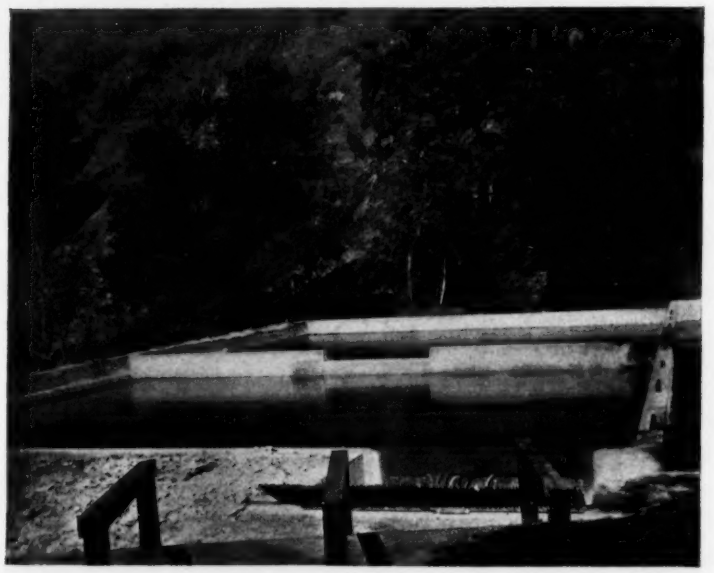


FIG. 6.—SANDBOX AND SCREEN OVER PIPE LINE AT NO. 3 MILL CREEK HEADWORKS.

separate chambers from which sediment can be sluiced out without disturbing the flow of water into the pipe line. The slope of each of these chambers toward the sluice gate is 4 ft. in 50. The walls separating the chambers are all lower than the surface of the water in the sandbox, with the exception of the main dividing wall through the center, which reaches to the elevation of the outside walls. This main wall is designed in order to operate the sandbox in sections; one section being used for supplying the plant while the other is sluiced out. The sandbox has operated with great success and has effectually freed the water of sediment, which is a very important item for a plant having the high pressure of this one.

There are five inverted syphons of steel pipe across ravines which cannot be spanned by concrete pipes. These syphons are described in above table.

No. of siphon.	Length in lineal feet.	Diameter of Pipe in inches.	Thickness of pipe shell, B. W. G.
1	850	30	12
2	315.5	22	14
3	120	30	12
4	150	30	12
5	2150	22	14

Blow-offs and air valves, as well as taper inlets, are provided for all of these syphons and the capacity is uniform—20 second-feet for each—regardless of the fact that the diameter varies from 22 to 30 in. The capacity is regulated by the grade of the syphons; the smaller diameter of pipes having a greater difference in elevation between the two ends, by which means the capacity is increased.

There are 25,190 linear ft. of concrete pipe laid in a hydraulic grade along the sides of the mountain and through the tunnel, for conducting the water to the head of the force main. The shell of this pipe is 3 in. in thickness, with 32 in. inside diameter, and consists of wash sand and gravel such as would pass through a screen of 2¼-in. mesh, two parts by measure to one part of Portland cement. This class of pipe is manufactured by thoroughly mixing and wetting the mortar, and mixing the pipe in molds especially designed for that purpose. All the pipe was originally made in 2-ft. sections. These were joined when laid in the trench by heavy cement collars

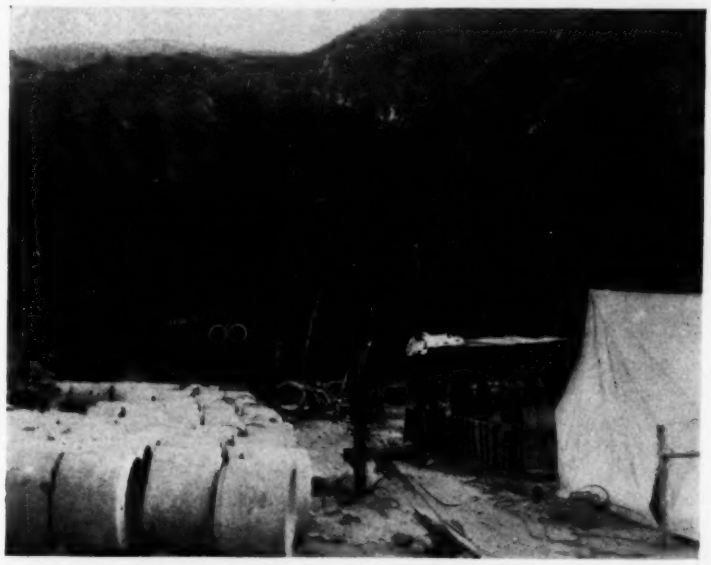


FIG. 7.— CEMENT PIT YARD OF NO. 3 MILL CREEK.

on the outside and smooth plaster on the inside of the joint. A tenon and groove are cast on opposite ends of each pipe section, which meet when laying the pipe, thus making the strength of the joint equivalent, if not superior, to the strength of the pipe shell itself. This concrete pipe is all laid in trenches and back-filled to a depth of about 3 ft. above the top, except in the tunnels where a fill is made between the pipe and the slides of the tunnel to a point slightly above the invert on each side. The grade of the pipe is two-tenths of a foot per 100 ft., which gives the line a carrying capacity of 20 cu. ft. per second. Fig. 7 shows one of the cement pipe yards during construction with a 5,200-ft. hoist used in carrying the pipe to the conduit grade.

There are in all twenty tunnels on the line of Mill Creek No. 3; nineteen of these being along the grade line for the concrete pipe, and tunnel No. 20 being on the force main at a point where the pressure pipe is laid beneath a heavy slide. The length of each of these tunnels is given in the following table:

No. of Tunnel.	Length in feet.	No. of tunnel.	Length in feet.
		1 to 10	3232.6
1	350	11	498
2	550	12	950
3	175	13	236
4	330	14	406
5	111.6	15	294
6	382	16	157
7	396	17	1067
8	190	18	400
9	135	19	190
10	613	20	70
	3232.6		7500.6

At the end of the gravity conduit is constructed a petty reservoir with a capacity sufficient to give a continuous flow of 10 second-feet of water for six hours. The purpose of this reservoir is to store water during the hours of the day when the load on the power plant is at a minimum for use on the peak load occurring in the evening. The reservoir is formed by means of an earthen dam 20 ft. long at the bottom and 166 ft. long on top, with a concrete core, and up stream slope paving. All places on the sides and bottom of the reservoir which are not of solid rock are paved in concrete to render the structure impervious to water. The 10 second-feet of water for six hours each day available by means of this storage will assist the capacity of the plant to the extent of 1,500 hp during the peak load, which is an extremely important consideration.

The force main from the petty reservoir to the power station is approximately 8,400 ft. long, and has a fall of 1,960 ft. It consists of the following diameters of pipe:

2485 feet of 26-in. pipe.
2150 feet of 24-in. pipe.
3450 feet of 24-in pipe expanded joint and solid welded flange pipe.
82 feet of 18-in. pipe for branches.
233 feet of 14-in.pipe for branches.

All of the 24-in. and 36-in. pipe is continuous-riveted pipe, varying in thickness from No. 14 to No. 0000 B. W. G., while all of the expanded-joint pipe and the pipe with solid steel flanges is lap welded, varying in thickness from ⅞ to 7/16 of an inch. A portion of the lap-welded pipe at the lower end is wound with 3/16-in. diameter crucible steel wire to add further to its strength. This wire is fastened at one end to a flange and applied to the pipe under tension in a lathe, after which it is dipped with a heavy coating of asphaltum. The 18-in. and 14-in. branch pipes are lap-welded pipes of ⅝ and ½-in. shell respectively. The material from which the No. 3 Mill Creek force main is manufactured is open-hearth, box-annealed steel, varying in tensile strength from 40,000 to 60,000 pounds per square inch. All joints are riveted, excepting those on the 14-in. and 18-in. branches, and on about 600 ft. at the lower end of the force main itself. These exceptions are made with joints of steel flanges, which are welded to sections of the pipe. The branching of the main pipe line into the two 18-in. branches and the re-subdivision of these in the two 14-in. branches, occurs by means of cast-steel Y's, having radii along their curved sides of from 9 to 12 ft. The force main is well equipped with air valves, air standpipe, blow-offs and five air chambers to prevent water-hammer on the line. An air chamber is illustrated in Fig. 8.

The joints used on the riveted pipe of the force main were made by means of a single row of rivets, the joints being what are known as "round seams." A description of the work is as follows: The holes

FIG. 8.—AIR CHAMBER NO. 3, MILL CREEK PIPE LINE, PRESSURE 834 LBS.

are punched with a multiple punching machine in a manner to make them all meet fairly when the sections of pipe are pulled together. The joint is then riveted, cold rivets being used on all gauges lighter than No. 8 B. W. G. and hot rivets for all heavier gauges. After the seams are riveted the pipe is chipped and calked to make a perfect union, metal to metal, entirely around the circle of the joint. Where the lap in the joint occurs the metal of the overlapping sheet is chipped and calked in the same manner. After this is done the inside and outside are painted with asphaltum to protect the pipe against the action of water and soils.

The joints on lap-welded pipes are made in two different ways. On the lighter pipes what is known as the "expanded" or "pump" joint is employed. One end of the pipe section is swelled sufficiently to permit the other to enter it. Holes are punched through both thicknesses of metal where the insertion of one pipe into another is made and the riveting is done by means of hot rivets in the same

manner as described for round seams. The joint is also chipped and calked in the same manner as on riveted pipe. For the lighter gauges of lap-welded, expanded-joint pipe, one row of rivets is employed in making the joint, but for metal having a thickness of from ⅝ to ¾ of an inch, two rows are used, and the rivets staggered in the same

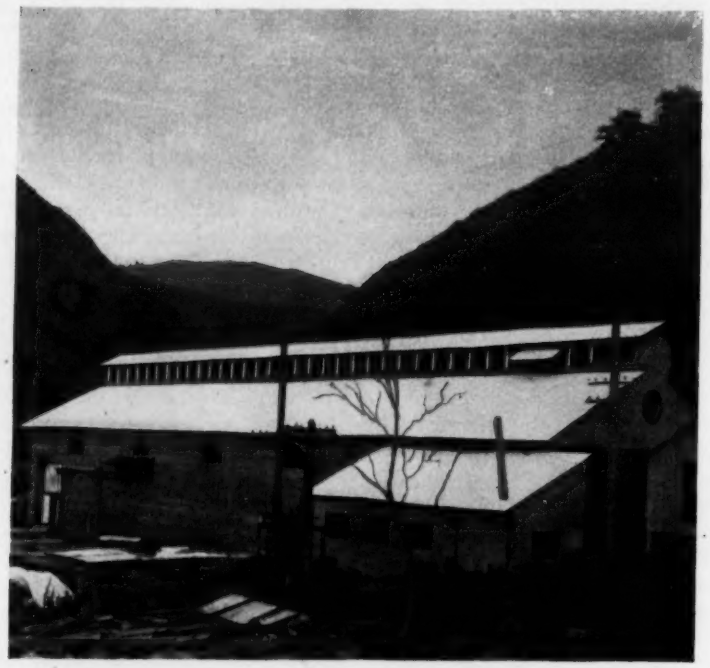


FIG. 9.—MILL CREEK STATION NO. 2 AND NO. 3.

manner as when making straight seams on riveted pipe. The diameter of rivets used for these heavier pipes is ⅞ inch.

A portion of the lap-welded pipe is made with solid welded steel flanges. The joint employed in laying these pipes is based on the principle of a groove running entirely around the flange, into which is squeezed a ⅝-in. circular rubber gasket. This gasket is made in the form of a circle and not of the exact diameter of the groove in the flange. It is inserted into the groove and pressed into the space

FIG. 10.—SPILLWAY FLUME OF NO. 3 MILL CREEK EMPTYING INTO HEADWORKS OF NO. 2 MILL CREEK.

formed when the flanges are drawn together so as to have their faces come metal to metal. The principle of this joint is excellent, since the possible escape of water from the interior of the pipe and the pressure against the rubber gasket which may be due to it, simply tend to press the gasket more firmly into the recess in the flange, thereby making an absolute guarantee against leaks. There is no chance for this gasket blowing out since the flanges are drawn up by means of bolts so as to have the two metal faces in perfect contact.

The nozzles and tail-races for Mill Creek No. 3 plant are below the floor of the power house, as is the case with the No. 2 plant. The power station containing the installations called Mill Creek Nos. 2 and 3 (these being within the same building) is 37½ ft. in width by 126 ft. in length, inside measurement. The building is of concrete throughout, with steel truss roof, covered with galvanized corrugated iron. The walls and foundations of the machines of station No. 3 were finished in 19 days after the work was started. The completed station building is illustrated in Fig. 9.

The separate tail-races from the generators of both Mill Creek No. 2 and No. 3 unite in a main tail-race from which the water passes into the flume connecting with Mill Creek No. 1 pipe line, as mentioned before.

Leading from the petty reservoir from the head of No. 3 force main to connect with the waste flume of the No. 2 plant is a similar waste flume about 7,500 ft. in length. There is a spillway over the dam of the petty reservoir, the water from which enters this waste flume directly and is conducted into the No. 2 waste flume and thence to the head of the No. 1 pipe line. Fig. 40 shows this spillway flume as it empties into the headworks of station No. 2.

A Practical Vector-Diagram for Induction Motors.

By H. C. Specht.

THE difficulty of making a satisfactory brake test on induction motors, as well as the lack of an accurate method for calculating the power factor, is well known. The determination of the characteristics of a given induction motor by the usual methods not only requires a very long time, but also introduces comparatively large inaccuracies and considerable disagreement between duplicate motors of the same type and size.

The use of vector diagrams for the study of induction motors has been investigated by several men, but only a few of the methods proposed are in use. Heyland confined his attention to polyphase motors, for which his method is fairly accurate when the motors are of large size (approximately over 5 hp). Ossana devoted his attention to small-sized polyphase motors and produced a diagram similar to that of Heyland, but introduced too much complication for practical use. Goerges investigated particularly single-phase motors, but his method calls for too much calculation. Bragstad worked on all sizes of polyphase and single-phase motors, but his diagrams are also too complicated for general use.

While in individual cases each of the above methods might be used successfully, yet their very number and their complexity obviously forbid their employment in general shop service.

Modifications which I have introduced into the Ossana and Bragstad diagrams give us a diagram which can be used with a great saving of time, with considerable accuracy, and with the great advantage of being applicable to single-phase as well as to polyphase induction motors of all sizes.

For any of the above-mentioned vector diagram methods only three measurements are necessary, as follows:

First, a careful measurement of primary amperes and watts to the motor running with no load at full voltage. Second, an equally careful measurement of primary amperes and watts with motor locked, to be taken at any proper voltage, the current then being calculated for full voltage, and the power factor calculated from the tested values. Third, the ohmic resistance of the primary winding.

POLYPHASE MOTORS.

Short Theory and Application.

In a polyphase motor the interlinked magnetic flux moves along the surface of the primary part like a wave and with a velocity equal to the number of alternations divided by the number of poles.

A no-load current $= i_0$ is required for generating this magnetic flux, its value being expressed as follows:

$$i_0 = \frac{E_0 \; 10^8}{4.44 \; k f \; \frac{q}{2} \; \frac{\sqrt{2}}{R} \; \frac{\bar{n}_1^2}{P} \; N,} = y_0 \; E_0, \qquad (1)$$

Where E_0 = effective primary volts of mutual induction,
f = constant depending upon the style of winding,

k = constant depending upon the style of core,
n_1 = number of turns in the primary winding,
P = number of poles,
N = frequency,
R = total magnetic resistance,
y_0 = the no-load or exciting admittance,
q = number of phases,
and is constant for a constant voltage, E_0.

The admittance, y_0, has two components: g_0, the no-load conductance, and b_0 the no-load susceptance. Therefore, we may write formula (1) in the following manner:

$$i_0 = (g_0 + j\,b_0)\,E_0, \qquad (2)$$

where $E_0 g_0$ = current component for iron loss and $E_0 b_0$ = current component for magnetizing.

The frequency of the secondary is equal to the slip multiplied by the frequency of the primary, and by reducing the secondary to the primary system we have the current induced in the secondary equal to

$$i_2 = y_2 E_0 = (g_2 + j\,b_2)\,E_0, \qquad \text{where} \qquad (3)$$

$$g_2 = \frac{r_2/s}{(r_2/s)^2 + x_2^2}; \quad b_2 = \frac{X_2}{(r_2/s)^2 + x_2^2}; \quad y_2 = \frac{1}{\sqrt{(r_2/s)^2 + x_2^2}}$$

r_2 = secondary ohmic resistance reduced to primary,
x_2 = secondary inductive resistance reduced to primary,
s = slip,
y_2 = secondary admittance at slip, s,
g_2 = secondary conductance at slip, s,
b_2 = secondary susceptance.

Geometrically, adding the currents as given above, we have for the primary current, i_1,

$$\left.\begin{aligned} i_1 = i_0 + i_2 &= E_0\,[(g_0 + j\,b_0) + (g_2 + j\,b_1)] \\ &= E_0\,[(g_0 + g_2) + j\,(b_0 + b_2)] = E_0\,(y_0 + y_2) \end{aligned}\right\} \qquad (4)$$

The primary impressed e.m.f. is geometrically equal to E_0 + primary drop or

$$E = E_0 + i_1 Z_1 = E_0 + i_1 \sqrt{r_1^2 + x_1^2}, \qquad (5)$$

x_1 = primary inductive resistance.
r_1 = primary ohmic resistance,
x_1 = primary inductive resistance.

Therefore, from formula (4) we can, according to Prof. C. P. Steinmetz, represent an induction motor as in Fig. 1.

Now let us prove that the extremities of current vectors or admittance vectors lie on the circumference of a circle. First, we will investigate part II of Fig. 1.

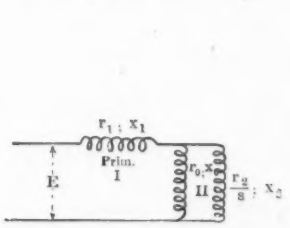


FIG. 1.—CIRCUITS OF POLYPHASE MOTOR.

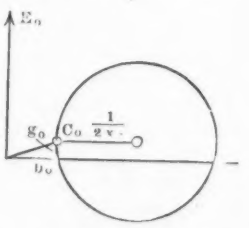


FIG. 2.—SIMPLE CIRCLE DIAGRAM.

Here we have $y^1 = y_0 + y_2 = g^1 + j\,b^1$, in which y_0 is constant, but y_2 is variable, owing to the ohmic resistance which varies inversely as the slip and equals r_2/s. Therefore:

$$\left.\begin{aligned} g^1 &= g_0 + \frac{r_2/s}{(r_2/s)^2 + x_2^2} \\ b^1 &= b_0 + \frac{x_2}{(r_2/s)^2 + x_2^2} \end{aligned}\right\}$$

By eliminating r_2/s in the above expressions we obtain:

$$(g^1 - g_0)^2 + \left(b^1 - b_0 - \frac{1}{2x_2}\right)^2 = \frac{1}{4x_2^2}, \qquad (6)$$

which is the equation of a circle (Fig. 2), since everything is constant except g^1 and b^1.

Now, since the primary admittance is constant and in series with the resultant admittance of part II in Fig. 1, it may be easily shown by the following graphical method that the resultant admittance of the whole circuit of Fig. 1 also lies on the circumference of a circle:

Let OC in Fig. 3 represent, in magnitude and direction, the resultant admittance of part II (Fig. 1) at any slip, and OA represent the primary admittance, or the admittance of part I. If parts I and II (Fig. 1) where in parallel the total admittance of the circuit would be OB, but since parts I and II are in series the resultant admittance or total admittance is found as follows:

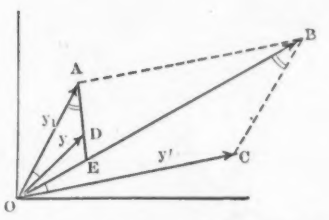


FIG. 3.—DIAGRAM OF ADMITTANCES.

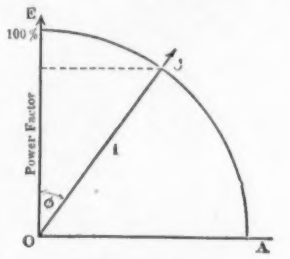


FIG. 4.—REPRESENTATION OF POWER FACTORS.

Draw the line ADE, making the angle $OAD = OBC$. Draw OD, making the angle $AOD = BOC$; then OD represents in magnitude and direction the total admittance of the circuit shown in Fig. 1.

By finding several values of y in the above manner and drawing a smooth curve through them, we will find that this curve is a circle. For a more complete description of the above and also a mathematical proof, see O. S. Bragstad's "Beitrag zur Theorie und Untersuchung von Mehrphasigen Asynchron Motoren."

With the above proof, that the extremities of the current vectors lie on the circumference of a circle, we will pass to the practical method of finding this circle.

From the zero point of a rectangular co-ordinate system lay off the current vectors, $i_0 = O\,C_0$, the no-load current, and $i_L = O\,C_L$, the current from the locked test for full voltage, in the direction of their respective power factors, $cos\ \phi_0$ and $cos\ \phi_L$, the ordinate axis being taken in the direction of the impressed voltage. (See Fig. 9.)

This gives us two points, C_0 and C_L, and leaves but one thing more to completely determine the circle. This we obtain as follows:

Draw through the point C_0^1 (C_0^1 = tested no-load minus the primary copper loss), a line, $C_0^1 Oc$, making the angle ϵ with the base line, OA. The intersection of this line, $C_0^1 Oc$, with the perpendicular to $C_0 C_L$ at its middle point will give us the center of the circle. The angle is found from the following formula:

$$tan\ \epsilon = \frac{i_0^1 r_1}{E}. \qquad i_0^1 = approx.\ i_0. \qquad (7)$$

However, if we could obtain the theoretical no-load point, i. e., the no-load without friction, windage and copper loss, then we would use the following formula:

$$tan\ \epsilon = \frac{i_0^1}{E}[r_1 + (x_1 + x_2)\ cos\ \phi_0^1]. \qquad (7A)$$

But since we cannot obtain this theoretical no-load point we neglect $\frac{i_0^1}{E}(x_1 + x_2)\ cos\ \phi_0^1$ to compensate for the friction and windage, except in very small motors, where the friction is low compared to the iron loss. In such cases formula (7A) gives more accurate results.

These formulæ have had practical application, daily, for the past six months and have given very satisfactory results.

Power Factor.

Draw a quadrant with o as center and with a radius which can be conveniently divided into 100 parts (Fig. 4).

The intersection of any current vector with this quadrant can be projected on the vertical axis, which is the direction of the impressed e.m.f., where it will indicate the power factor in per cent.

Determination of the Separate Losses, Input, Output, etc.

As first shown by Ossana, and later in a more elaborate manner by Bragstad, all such values as losses, input, etc., can be obtained for any given current by multiplying the perpendicular distance from the current point to the base line of that loss or input, etc., by a constant.

I.—Primary Copper Loss.

In Fig. 5 let O be the zero point and OE the direction of the impressed voltage. The circle represents the current circle.

C is any current point. Oc is the center of the current circle. OT is tangent to the circle from O, and R is the radius of the circle. TN and CD are perpendiculars to the line $O\,Oc$. AB is

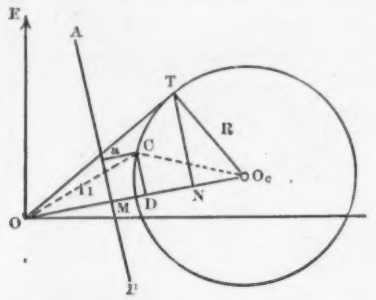


FIG. 5.—REPRESENTATION OF PRIMARY COPPER LOSS.

the base line of primary copper loss, and is vertical to ON at the middle point, M. Line a is the perpendicular distance from C to AB. The primary copper loss is $a \times$ constant. Referring to Fig. 5,

$$
\begin{aligned}
&OD^2 + CD^2 = OC^2 = i_1^2\\
&(O\,Oc - O\,D)^2 + CD^2 = R^2\\
&O\,Oc^2 + O\,D^2 - 2O\,Oc \times O\,D + CD^2 = R^2\\
&OD^2 + CD^2 = R^2 - O\,Oc^2 + 2O\,Oc \times O\,D = i_1^2\\
&R^2 - O\,Oc^2 = -\,O\,T^2\\
&i_1^2 = -\,O\,T^2 + 2O\,Oc \times O\,D\\
&O\,T^2 = O\,N \times O\,Oc\\
&i_1^2 = O\,Oc \times (2O\,D - O\,N) = 2 \times O\,Oc \times (O\,D - O\,M)\\
&i_1^2 = 2O\,Oc \times a\\
&i_1^2 r_1 = 2r_1 \times O\,Oc \times a = a \times const. \qquad (8)
\end{aligned}
$$

From formula (8) we see that the primary copper loss is equal to the perpendicular distance (a) multiplied by a constant.

II.—Iron Loss

In a similar manner we could prove that the iron loss equals a^1 (Fig. 6) multiplied by a constant. A^1B^1 (Fig. 6) is taken per-

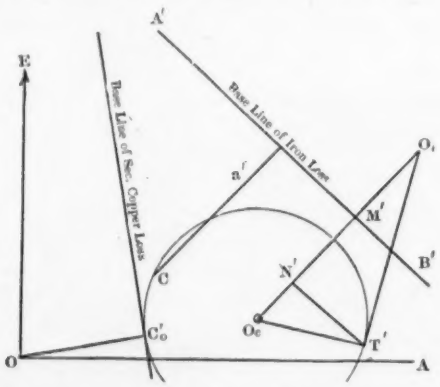


FIG. 6.—REPRESENTATION OF SECONDARY COPPER LOSS AND IRON LOSS.

pendicular to and at the middle point, M^1 of N^1O^1, the co-ordinates of O_1 being ($E \times b_1 = E \times$ primary susceptance and $E \times g_1 = E \times$ primary conductance, if the diagram circle is to an ampere scale).

I believe that this will suffice to show the method of finding the base lines of the separate losses, total losses, input, output, etc., and next we will consider the practical method of locating these lines.

III.—Secondary Copper Loss.

In Fig. 6 let C_0^1 be the theoretical no-load point. As this point is the only point at which there is no secondary copper loss, it is quite evident that the base line of secondary copper loss must pass through this point and be tangent to the circle.

IV.—Primary Input.

The corresponding base line is the abscissa, OA (Figs. 6 and 9), and therefore the distance from any current point to this line multiplied by a certain constant (in this case $\frac{E}{746}$) represents the real input (horse-power) for that current. If anywhere from the base line, OA, we draw to a proper scale a line to show the real input hp $= \frac{Ei}{746} \cos\phi$, then a parallel line to the base line, OA, passing through any current point will mark off directly as corresponding real input (horse-power) the part of the line between a_1 and the intersection (see Fig. 9).

V.—Secondary Output.

Since at the no-load point, C_0 (Fig. 9), and at the locked point, C_L, there is no secondary output, the base line for output will be C_0C_L. Therefore, a line drawn through any current point parallel to C_0C_L will cut off the output from a corresponding scale. The scale can be obtained similarly to that for input by calculating the output (horse-power) for one point (preferably for about full load).

The horse-power output is equal to the real input (horse-power) $\times$ real efficiency. The method of finding the real efficiency I will take up later.

VI.—Torque.

By reference to Fig. 1 we see that at no-slip, which corresponds nearly to the no-load, the effective secondary resistance $= \infty$; that is to say, there will be no current in the secondary part, and, therefore, no torque.

Likewise, we can take the slip theoretically $= \infty$; that is, the effective secondary resistance $= 0$, and, therefore, the torque for this point (C_m in Fig. 9) is equal to 0. Now a line through C_0 and C_m will represent the base line for torque. By neglecting the no-load admittance, which in most cases is permissible, we can find the power factor for the point C_m by the following formula:

$$\cos\phi_m = \frac{r_1}{\sqrt{r_1^2 + (x_1 + x_2)^2}}, \qquad (9)$$

$$X_1 + X_2 = \frac{1}{i_L}\sqrt{E^2 - \left(\frac{P_L}{i_L}\right)^2} = \frac{\sin\phi_L \times E}{i_L},$$

in which P_L = watts on locked,
i_L = current on locked,
ϕ_L = angle of power factor on locked.

If N = synchronous speed, the torque in pounds $= \frac{33{,}000}{2\pi N} \times$ secondary input horse-power $= const. \times second\ input\ hp$. Therefore, a line drawn through any current point parallel to C_0C_m will cut off the torque from a corresponding scale. The torque scale above C_0C_m can be obtained in the same way as the input and output scales by calculating the torque for one point (preferably at full load).

$$lbs.\ torque = \frac{5{,}250 \times hp\ output}{N\ (1 - S)}.$$

The slip will be discussed later.

The maximum or pull-out torque can be obtained on the torque scale by drawing a tangent to the circle parallel to C_0C_m and also the starting torque by drawing a parallel to C_0C_m through C_L.

VII.—Total Losses.

The base line for the total losses will be a combination of the base lines of the separate losses (for iron loss, primary copper loss and secondary copper loss) as follows:

The resulting base line (a_3V_{01}) of total primary losses must pass through the intersection of the base line of iron loss and primary copper loss, and through the intersection (a_3) of the base line of primary real input (OA) and secondary real input (C_0C_m). (See Fig. 9.)

As the intersection of the base line for iron loss with that of primary copper loss is generally too far away from the diagram circle, it is better to calculate the slope of the base line (a_3V_{01}) by the following formula:

$$\tan a = \frac{Ebc - x_1T^2}{r_1T^2 - E\,gc - 2d\,(bcr_1 - gcx_1)}. \qquad (11)$$

In this expression,

$x_1 = x_2$ approx., with reference to primary winding,

In amp. scale.
- d = distance from O to the intersection of the primary and secondary input,
- bc = abscissa of the center, Oc,
- gc = ordinate of the center, Oc,
- T = tangent from O to the circle above OA.

Finally, the base line of the total losses (primary and secondary)

must go through the intersection, a_2, of the base line of primary input, $O\,A$, and secondary output, $C_0\,C_L$, and through the intersection of the base line of the total primary losses and the secondary loss.

This latter intersection point will be in general too far away, but the base line of the total losses can be obtained by drawing a line through the point a_2, which divides the space between the base line of total primary losses and of the secondary loss in the proportion of $\frac{d_1}{d_2}$ (see Fig. 9).

In the examples at the end of this paper the slopes of the lines discussed above, i. e., total loss and primary total loss lines, were found by calculation, and it will be seen that for the three-phase motor these lines are very nearly parallel to the secondary loss line. In practice these lines can be taken parallel to the secondary loss line without any appreciable error, except where the conditions are extremely severe, as in the case of the small single-phase motor illustrated below (see Fig. 12).

VIII.—Real Efficiency.

In Fig. 7 let C be any current point, C_0C_L the output base, $O\,A$ the

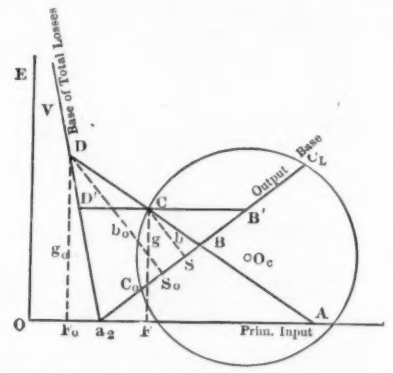


FIG. 7.—REPRESENTATION OF EFFICIENCY.

primary input base, and a_2V the base line of total losses. Through C draw any line, $A\,C\,D$.

Let b and b_0 be the perpendicular distances from C and D, respectively, to the output base line; g and g_0 are perpendiculars from C and D, respectively, to the primary input base line ($O\,A$).

As shown previously, the output at a point, C, is $b \times K$, and the primary real input is $g \times K^1$; K and K^1 being constants. The efficiency is $\frac{b \times K}{g \times K^1}$.

Since the point D is on the total loss line we know that there are no losses at this point, because the perpendicular distance of D to this line, a_2V is zero, and therefore the efficiency at $D = \frac{b_0 \times K}{g_0 \times K^1} = 1$.

From this we have $\frac{K}{K^1} = \frac{g_0}{b_0}$.

At C the efficiency $= \frac{b}{b_0} \times \frac{g_0}{g}$.

From the similar triangles, $B\,C\,S$ and $B\,D\,S_0$, $\frac{b}{b_0} = \frac{B\,C}{B\,D}$.

And from the triangles $A\,C\,F$ and $A\,D\,F_0$; $\frac{g_0}{g} = \frac{A\,D}{A\,C}$, the efficiency $= \frac{B\,C}{B\,D} \times \frac{A\,D}{A\,C}$.

If we draw the line $A\,C\,D$ parallel to the primary input line, $O\,A$, then $\frac{A\,D}{A\,C} = \frac{\infty}{\infty} = 1$. The efficiency $= \frac{B^1\,C}{B^1\,D^1}$.

Therefore, a line drawn parallel to $O\,A$, such that the portion included between the base lines ($C_0\,C_L$) of output and a_2V of total losses can be divided conveniently into 100 parts, will give a scale on which the efficiency can be read directly. Upon this scale a line drawn from a_2 through any current point, C, will mark off the efficiency, reading from the base line of output to the base line (a_2V) of total losses (see Fig. 9).

IX.—Slip.

In Fig. 8 let C be any current point. Through C draw any line, $B\,F$, so as to intersect the secondary input base at some point as B. From F and C draw lines b_0, d_0 and d; b perpendicular to $C_0{}^1C_L$ and $C_0{}^1C_m$.

$$1 - s = \frac{Theor.\ sec.\ output}{Sec.\ input},$$

where s = slip.

For point C:

$$1 - s = \frac{d \times K_1}{b \times K_2},$$

where K_2 and K_1 are constants, but are not equal.

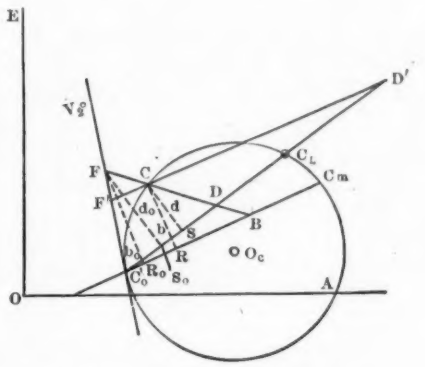


FIG. 8.—REPRESENTATION OF SLIP.

For the point, F, on the base line of secondary loss the slip is zero; in other words, secondary input and output are equal.

$$1 = \frac{d_0 \times K_1}{b_0 \times K_2}.$$

Dividing the above formula by this we have

$$1 - s = \frac{d}{d_0} \times \frac{b_0}{b}.$$

From the similar triangles, $D\,C\,S$ and $D\,F\,S_0$, we have $\frac{d}{d_0} = \frac{D\,C}{D\,F}$.

Also from triangles $B\,R\,C$ and $B\,R_0F$ we have $\frac{b_0}{b} = \frac{B\,F}{B\,C}$.

$$1 - s = \frac{D\,C}{D\,F} \times \frac{B\,F}{B\,C}.$$

Now, if we revolve the line $B\,C\,F$ about the point C until it is

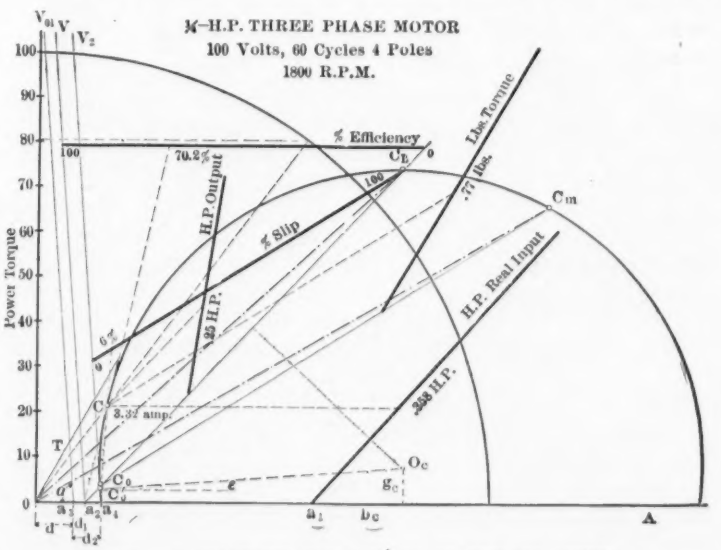


FIG. 9.—COMPLETE DIAGRAM OF POLYPHASE MOTOR.

parallel to $C_0{}^1C_m$ we will have the condition, $\frac{B\,F}{B\,C} = \frac{\infty}{\infty} = 1$, and therefore,

$$1 - s = \frac{D^1 C}{D^1 F^1},$$

$$s = 1 - \frac{D^1 C}{D^1 F^1} = \frac{D^1 F - D^1 C}{D^1 F^1} = \frac{F^1 C}{D^1 F^1}.$$

Now, if $F^1 D^1$ is taken of such a length that it can be divided conveniently into 100 parts, then a line drawn from C_0^1 through any current point C will cut off the slip directly in per cent.

To show the great advantage of this diagram, I have selected one of the early type of small motors (¼ hp) as an example, so as to obtain about the most unfavorable conditions met with in practice.

Example (*Fig.* 9).

¼-hp, 3 ϕ induction motor, in primary connection,

$E = 100$ volts, 60 cycles; $N = 1{,}800$ = synchronous speed.

a.—Tested

at no load:—$i_0 = 1.88$ *amp.*; $P_0 = 46.1$ *watts*; *cos* $\phi_0 = 24.5$ *per cent.*; $r_1 = 3.12\,w$ at 50° C. = *Prim. resist. per leg.*

at locked:—$i_L = 13.75$ *amp.*; $P_L = 935$ *watts*; *cos* $\phi_L = 68$ *per cent.*

b.—Calculated.

$$x_1 + x_2 = \frac{1}{i_L}\sqrt{E^2 - \left(\frac{P_L}{i_L}\right)^2} = \frac{1}{13.75}\sqrt{100^2 - \left(\frac{935}{13.75}\right)} = 5.33\,\omega.$$

Approx. $x_1 = x_2 = 2.665$; $P_0^1 = P_0 = i_0^2 r_1 = 46.1 - 1.88^2 \times 3.12 = 35$ *watts.*

Approx. $i_0 = i_0^1$; $\cos \phi_0^1 = \frac{P_0^1}{i_0 E} = \frac{35}{1.88} = 18.6$ *per cent.*

c.—Construction.

Draw a quadrant with O as center and with a radius = 5 inches.

Lay off the vectors i_0, i_0^1 and i_L (in *Fig.* 9 — $O C_0$, $O C_0^1$ and $O C_L$) in the direction of their respective power factors (1 *amp.* = 0.5 *inch*). Draw a perpendicular to the middle of the line joining the points $C_0 C_L$ and also through C_0^1 (corresponding to no-load watts minus primary copper loss = P_0^1) a line which makes, with the base, $O A$, an angle ϵ.

$$\tan \epsilon = \frac{i_0}{E}[r_1 + (x_1 + x_2)\cos \phi_0^1] = \frac{1.88}{100}[3.12 + 5.33 \times .186] = .077,$$

and this locates the center, Oc, of the diagram circle.

From O the current vector, i_m (Fig. 9 = $O C_m$) with the power factor

$$\cos \phi_m = \frac{r_1}{\sqrt{r_1^2 + (x_1 + x_2)^2}} = \frac{3.12}{\sqrt{3.12^2 + 5.33^2}} = 50.6 \text{ per cent.},$$

determines the point C_m, and then where the line $C_m C_0$ intersects the base, $O A$ (d = distance from O) draw the line for total primary losses ($a_3 V_{01}$) making, with $O A$, the angle α.

$$\tan \alpha = \frac{E\,bc - x_1 T^2}{r_1 T^2 - Egc - 2d\,(bcr_1 - gc\,x_1)} = \frac{100 \times 10.1 - 2.665 \times 5.8^2}{3.12 \times 5.8^2 - 100 \times 1 - 2 \times 1.1\,(10.1 \times 3.12 - 2.665)} = -15.7.$$

Then strike a tangent (line of secondary loss, V_2) to the diagram circle at C_0^1, and prolong this tangent to the intersection, a_4, with $O A$, and also $C_L C_0$ (intersection point, a_2). Finally, through the point a_2 draw the line $a_2 V$, of total losses, dividing the space between $a_3 V_{01}$ and $a_4 V_2$ in the proportion of $\frac{d_1}{d_2}$ ($d_1 = a_2 a_3$; $d_2 = a_0 a_4$).

a.—Efficiency.

A line drawn parallel to $O A$ and between $C_0 C_L$ and $a_3 V$ (length = 5 inches) gives the scale for efficiency.

In the figure the efficiency is shown for full load = 70.2 per cent. (measured from right to left).

b.—Power factor drawn for full load = 80.4 per cent.

c.—Real input horse-power may be calculated for any load by $\frac{Ei \cos \phi}{746}$, and for this value draw anywhere above $O A$ the scale of horse-power (1 hp = 5 inches). The real input for all other loads will be obtained on the scale by drawing lines parallel to $O A$ and through the corresponding current points. For full load in Fig. 9 real input = .358 hp.

d.—Output Horse-power.—In the same way draw anywhere above the line ($C_0 C_L$) the scale for horse-power output = real input ×

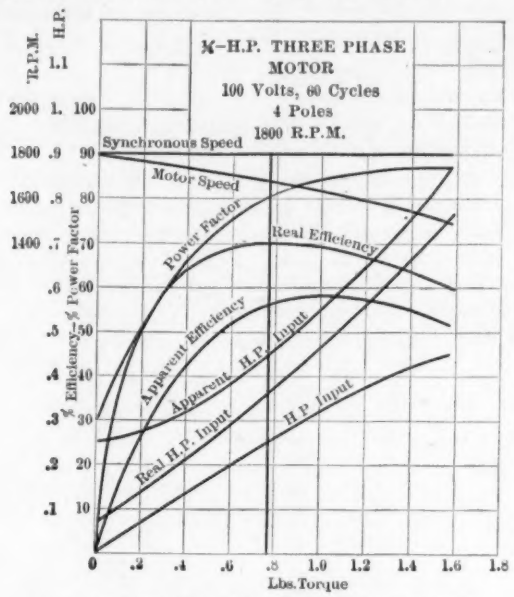


FIG. 10.—PERFORMANCE OF POLYPHASE MOTOR.

real efficiency and then lines drawn parallel to $C O_L$ will mark off on the scale the horse-power output For full-load horse-power output = 0.25.

e.—Slip.—A line (length = 5 inches) drawn parallel to $C_0^1 C_m$, and between $a_4 V_2$ and $C_0^1 C_L$ will represent the scale of slip. From C_0^1 a line through any current point will mark off the slip in per cent. (measured from left to right). For full load the slip = 6 per cent.

f.—Torque.—Draw the scale (1 pound = 2.5 inches) above the line $C_0 C_m$ in the same way as for input and output by pounds torque $= \frac{5{,}250 \times hp\ output}{N\ (1 - s)}$, and then parallel lines to $C_0 C_m$ through any current point will mark off the pounds torque on the scale. For full-load pounds torque = 0.77.

g.—Apparent hp by calculation = $\frac{Ei}{746}$.

For full load = $\frac{100 \times 3.32}{746} = .445$ *hp.*

h.—Apparent Efficiency.—By calculation, = $\frac{hp\ output}{app.\ hp} \times 100$.

For full load = $\frac{.25}{.445} \times 100 = 56.2$ *per cent.*

In Fig. 10 the different values obtained by the diagram are graphically plotted in terms of pounds torque. The results obtained above have been compared with the results worked up from brake test and from method by losses, and they compare very favorably.

2.—SINGLE-PHASE MOTORS.

In the single-phase motor the primary current generates an alternating magnetomotive force which is stationary in space, and if the secondary is open-circuited there is induced therein a corresponding alternating field likewise stationary in space. As is well known, such an alternating field, if sinusoidal, can be considered in two different ways, as made up of two separate fields:

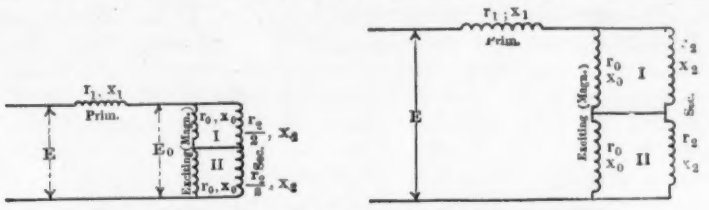
a. As employed by Goerges—into a principal alternating field and a cross alternating field, or

b. As apparently first employed by Maurice Le Blanc (*Lumière Électrique*, Vol. 46, Dec., 1892) into two fields rotating in opposition at the same speed; in line with which we will construct the following diagram:

The e.m.f's induced in the secondary are of different frequencies

and can, therefore, be considered individually; this holds also for a rotating squirrel cage winding.

In rotating, both these fields differ in strength, and indeed that field which revolves in direction with the rotation of the motor has the greater strength, while that field revolving in the opposite direction to this has the lesser. Near synchronism the inverse field is



FIGS. 11 AND 12.—CIRCUITS OF SINGLE-PHASE MOTOR.

nearly zero, and therefore the action of the motor becomes almost that of a polyphase motor. This condition can be represented by the following figure:

$$\text{The magnetizing admittance} = \frac{1}{\text{impedance}} = \frac{1}{\sqrt{r_0^2 + x_0^2}}$$

of part I (Fig. 11) is very small compared with the part

$$\frac{1}{\left(\sqrt{\left(\frac{r_2}{2}\right)^2 + x_2^2}\right)}$$

connected in parallel and can therefore be neglected.

With the exception that the primary resistance (r_1 and x_1) are thus increased by $\frac{r_2}{2}$ and x_2, we have practically the case of a polyphase motor and can, therefore, proceed accordingly, remembering, however, that in all formulæ we must substitute for r_1 and x_1 the values

$$\left(r_1 + \frac{r_2}{2}\right) \text{ and } (x_1 + x_2) \text{ respectively.}$$

It must be mentioned here that the measured short-circuit point is not the true one, and to show this we will refer to Fig. 12, where we see that part I of this figure does not correspond to part I of Fig. 11; the second ohmic resistance of part I should be $\frac{r_2}{2}$ instead of r_2, but from the short-circuit test, if we neglect the magnetizing admittance, we are enabled to calculate the ohmic resistance, r_2, and the inductive resistance $(x_1 + 2x_2)$ and after this the true short-circuited point.

$$r_2 = \frac{1}{2}\left(\frac{P_L}{i_L^2} - r_1\right); \quad (x_1 + 2x_2) = \frac{1}{i_L}\sqrt{E^2 - \left(\frac{P_L}{i_L}\right)^2}$$

P_L = measured watts on short-circuit (locked),
i_L = measured amperes on short-circuit (locked). } (tested)

The true short-circuit point is then calculated according to the formula:

$$i_L^1 = \frac{E}{\sqrt{\left(r_1 + \frac{3}{2}r_2\right)^2 + (x_1 + 2x_2)^2}}$$

$$\cos\phi_L^1 = \frac{r_1 + \frac{3}{2}r_2}{\sqrt{\left(r_1 + \frac{3}{2}r_2\right)^2 + (x_1 + 2x_2)^2}}$$

In accordance with this theory we are now ready to discuss a test and to construct a diagram for a single-phase motor. Again, we have selected a small motor of an early type in which the conditions are very unfavorable.

Example (*Fig.* 13).

¼-hp single-induction motor.

E = 100 volts, 7,200 alts.; N = 1,800 r.p.m. = synchronous speed.

a.—Tested.

at no load:—

$i_0 = 4.12$ *amp.*; $P_0 = 120$ *watts*; $\cos\phi_0 = 29.1$ *per cent.*;

at locked:— $i_L = 13.24$ *amp.*; $P_L = 900$ *watts*; $\cos\phi_L = 68$ *per cent.*;

$r_1 = 3.52$ *at* 50° *C.* = *primary resistance.*

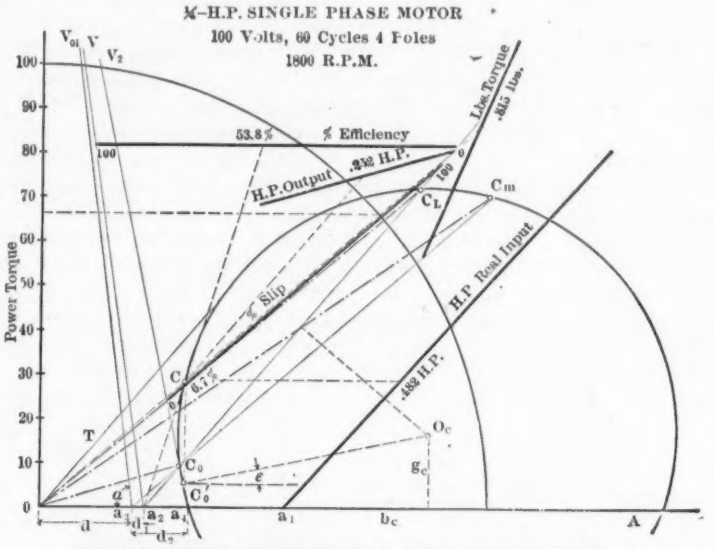


FIG. 13.—COMPLETE DIAGRAM OF SINGLE-PHASE MOTOR.

b.—Calculated.

$$X_1 + 2X_2 = \frac{1}{i_L}\sqrt{E^2 - \left(\frac{P_L}{i_L}\right)^2} = 5.53\ \omega.$$

Approx. $X_1 = 2X_2 = 2.765\ \omega$; $X_2 = 1.38$.

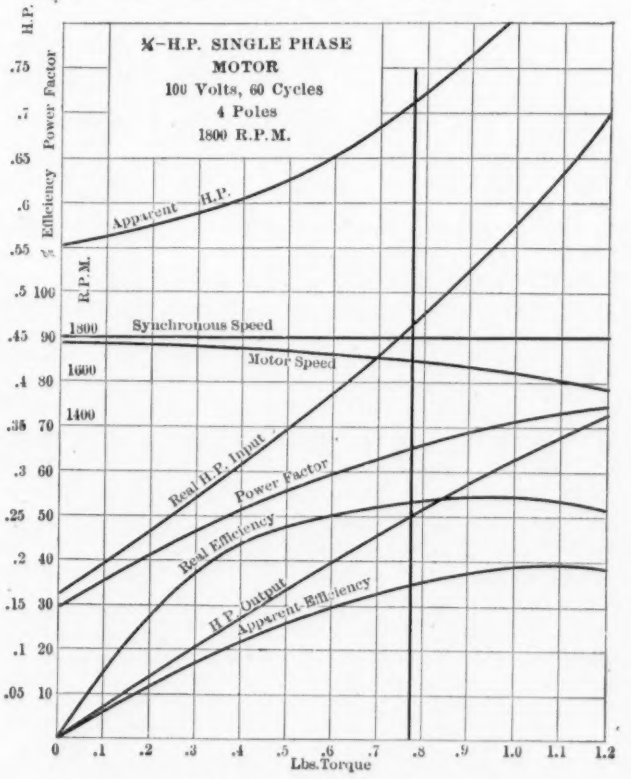


FIG. 14.—PERFORMANCE OF SINGLE-PHASE MOTOR.

$$r_2 = \frac{1}{2}\left(\frac{P_L}{i_L^2} - r_1\right) = .795\ \omega.$$

$$P_0^1 = P_0 - i_0^2\left(r_1 + \frac{r_2}{2}\right) = 53.5\ \textit{watts}.$$

$$\textit{Approx.}\ i_0 = i_0^1;\ \cos\phi_0^1 = \frac{P_0^1}{i_0 E} = \frac{53.5}{412} = 13\ \textit{per cent.}$$

the true current and power factor of short-circuit;

$$i_L^1 = \frac{E}{\sqrt{\left(r_1 + \frac{3}{2} r_2\right)^2 + (x_1 + 2x_2)^2}} = 13.8,$$

$$\cos \phi_L^1 = \frac{r_1 + \frac{3}{2} r_2}{\sqrt{\left(r_1 + \frac{3}{2} r_2\right)^2 + (x_1 + 2x_2)^2}} = 65 \text{ per cent.}$$

c.—Construction.—Draw a quadrant with O as center and with a radius = 5 inches. Lay off the vector, i_0, i_0^1 and i_L in the direction of their respective power factors (1 amp. = 0.5 inch). Perpendicular to the middle of the line joining the points ($C_0 C_L$) and through C_0^1 (corresponding to no-load watts minus primary copper loss = P_0^1), a line, which makes, with the base, $O A$, an angle ϵ:

$$\tan \epsilon = \frac{i_0^1}{E} [r_1 + (X_1 + X_2) \cos \phi_0^1] = \frac{1.88}{100} [3.12 + 5.33 \times .186] = .077.$$

The intersection of these two lines locate the center, O, of the diagram circle.

From O the current vector, im, with the power factor:

$$\cos \phi m = \frac{r_1 + \frac{1}{2} r_2}{\sqrt{\left(r_1 + \frac{1}{2} r_2\right)^2 + (x_1 + 2x_2)^2}} = 57.7 \text{ per cent.}$$

determines the point C, and then where the line ($C_m C_0$) intersects the base, $O A$ ($O a_2 = d$) draw the line for total primary losses ($a_2 V_{01}$), making, with $O A$, the angle,

$$\tan \alpha = \frac{Ebc - (x_1 + 2x_2) T^2}{\left(r_1 + \frac{1}{2} r_2\right) T^2 - Egc - 2d \left[bc \left(r_1 + \frac{1}{2} r_2\right) - gc (x_1 + x_2) \right]} = -8.1.$$

Then strike a tangent (line of secondary loss, V_2) to the diagram circle at C_0^1.

Finally, through the intersection point, a_2, of $C_L C_0$, draw the line $a_2 V$ of total losses, dividing the space between $a_2 V_{01}$ and $a_4 V_2$ in the proportion of $\frac{d_1}{d_2}$.

Now, draw all the different scales in exactly the same way as in the example for the ¼-hp, three-phase induction motor in Fig. 9.

In Fig. 13 on the different scales the values are indicated only for 5.4 amp. (primary), while the curves in Fig. 14 (obtained from this diagram) show the action of this motor from zero load up to about 50 per cent. overload.

As was mentioned before the total loss line ($a_2 V$) of the polyphase motor (¼-hp; see Fig. 9) is very nearly parallel to the secondary loss line ($C_0^1 V_2$) and in practice may be taken parallel. For larger sizes of single-phase motors the error of assuming it to be parallel is also quite small.

From this brief description the theory of this new diagram may seem involved and hard to understand; nevertheless, its practical application is relatively very simple and requires but a short time for its completion. One who has had practice with this diagram could determine in two hours the curves required from a brake test, while, on the other hand, the customary computation by the loss method with correction for primary ohmic drop would require for even an experienced man seven hours. Moreover, mistakes can easily arise in the latter method and often of such a nature as to necessitate the repetition of the entire calculation, while with the graphical method errors are promptly detected.

To those who engage regularly and daily in such work, the advantages of the diagram method described above in comparison with the tedious algebraic methods, will be apparent at once.

Comparative Voltages: Grounded Transmission Mediums.

By J. Stanley Richmond.

THE environment of each path in life produces on those who walk it little mannerisms by which the various travelers become more or less conspicuous. Thus it is that different nations have different ways whereby they give expression to their thoughts; or, popularly defined, each nation has its own language. Similarly, each branch of the engineering profession has, to a certain extent, its own terminology; and, in many cases, even individual members of one engineering branch have their own way of expressing themselves. Particularly is this the case with a specialist who finds it necessary, in order to explain the solution of a problem, either to elaborate certain theories or to be a purist.

It is probably somewhat known that the writer has been rather particular of late in regard to the use of the terms "voltage," "potential," "direction of action" (transmission), "negative," "positive" and "current"; and, in fact, that the last three are very rarely used by him. Formerly, however, he used all these terms in the popular way generally followed; and he has a very vivid recollection of the considerable difficulty which he experienced in changing from the method of so using them to the more restricted method which he has lately adopted. Again, it is assumed that the present popularity of explaining the solutions of many problems by the use of diagrams is due to this fact of individual terminology; for diagrams, similar to the pictorial writings of our ancient forefathers, can be more or less understood by all. Tautology, too, is sometimes necessary for the sake of clearness. The writer, therefore, will endeavor to be broad-minded by remembering these facts in the following explanation of a somewhat interesting phase of the operation of grounded transmission mediums (track returns).

An embryo expert, lately engaged in taking electrolytic survey potential readings in connection with the operation of an elevated

FIG. 1.—NO TRAIN IN VICINITY OF STATION.

railroad system, reported that "a certain hydrant was positive when a train was traveling in one direction, and that it was negative when the train was traveling in the other direction."

Now, to solve this or any similar problem requires that the expert shall form his equation by an analysis of the observations, which he has made, on the basis of what may be termed comparative voltages; that is, that he must obtain a clear mental vision of the relative voltages of the various points under observation during each condition of operation. This is as easy as saying one's "A B C" if the writer's method of analysis is adopted; but by the older method of analysis it is rather a complex operation.

Apropos of the foregoing, it must be remembered, though simplicity is greater than complexity, that the faculty of true simplicity in solving problems is only acquired by first diving into the depths of one or more forms of complexity. Simplicity, therefore, means, if one lives in Harlem and desires to go to the Battery, that one should not go there via San Francisco, but that one should go there via the intervening portion of the City of New York. The complexity traveled through in such case before the required simplicity is developed is evidenced by the fact that a new-born babe has to spend many years acquiring a knowledge of the streets, railways and other routes between the two points, and, incidentally, much other information. As another illustration, take the case of "Hertz on Electrical Waves," the complexity of which, after careful study, can be reduced to the simplicity of a knowledge of electrical balance and the medial (neutral) point.

In so far as the problem in hand is concerned, it is only customary to take these readings in the neighborhood of stations; and so the writer concluded that the hydrant was situated close to one of them, and that its normal electrical state, during operation, was above that of (positive to) the structure, and that this was also the case when a train was approaching and entering the station; and that the reversal of the comparative voltages of the hydrant and the structure—that is, the voltage of the hydrant below that of (negative to) the structure—resulted when a train was starting out of and traveling away from the station. These conclusions were acknowledged to be cor-

rect by the embryo expert. Consider, therefore, the diagrammatic illustration marked Fig. 1, in which *A* is the generator with its low-voltage (negative) pole *B* earthed and connected to the bonded structure and rails, *E F;* that *C D* is a pipe line; that *J* is the station where the observations were made; that *L* is the hydrant, and that *G, H* and *K* are other stations.

Assume that the voltage of the hydrant, when no train is in the vicinity of the station, is ten volts above and the voltage of the structure at the same time and point is eight volts above the voltage of the low-voltage (negative) side of the generator; or, in less particular phraseology, that the pipe drop is ten volts and the track drop is eight volts. The same conditions will exist, therefore, when a train is approaching or entering the station; and such can be

FIG. 2.—VOLTAGES WHERE TRAIN IS APPROACHING STATION.

shown diagrammatically by Fig. 2, in which the figures are the voltages of the different points.

That the comparative voltages of the hydrant and the structure in the vicinity of the station are the same when a train is approaching and entering the station as when no train is in the neighborhood of the station will be understood when it is remembered that the motorman shuts off the power when the train is quite a distance from the station; and that, after coasting until the station is nearly reached, he enters such with the brakes on.

Now, assume that the train is starting out of and traveling away from the station, in which case the starting torque and requirements of acceleration will necessitate the use of a considerable amount of power. As a result of the increased use of power at this point, the voltage of the structure will be raised; though—and herein lies the crux of the whole question—the voltage of the hydrant will remain, practically speaking, the same as before. The voltages of the differ-

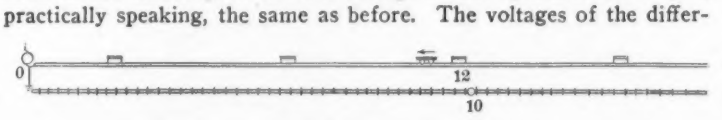


FIG. 3.—VOLTAGES WHERE TRAIN IS LEAVING STATION.

ent points during this period can be diagrammatically illustrated; therefore, as shown in Fig. 3, in which the figures are those of the voltages of the respective points.

It appears, therefore, that an expert possessing a true knowledge of the theory of comparative voltages should, in such a case as has been dealt with, report somewhat as follows:

CARLYLE RAILWAY,
Eldon Moor, Auckland.

Detail Report.

ELECTROLYTIC EXPERT'S OFFICE,
ELDON MOOR, February 14, 1905.

Mr. Thomas Charlton, Electrical Engineer, Carlyle Railway Company, Eldon Moor.

DEAR SIR:—I have to report an interesting series of observations made in the vicinity of the Armstrong Street station of the Charnley branch.

The hydrant at this point appears generally to be about two volts higher than the voltage of the adjacent structure, due, of course, to loads at distant points. This state of affairs remains unaltered when a train is approaching or entering the station, because during coasting and braking the train is using no power. When a train is departing and traveling away from the station, however, the heavy load thrown on the structure due to the starting drawbar pull and the requirements of acceleration appears to raise the voltage of the structure about four volts at this point, whereby the voltage of the hydrant is then about two volts below the voltage of the adjacent structure.

I have detailed by assistant, Mr. Cook, to make investigations for some distance on both sides of the station with a view to locating any possible connection between the structure and the water mains; and if he locates one I will duly notify you of the fact, so that arrangements may be then made whereby we can confer as to the advisability or otherwise of removing the same. Yours truly,

J. ERGHOLME, *Electrolytic Expert.*

Proposed Central Power Station for Executive Buildings, Washington, D. C.

In a report to Congress the Superintendent of Library Building and Grounds has submitted preliminary plans and estimates of cost of a central power station for certain Government buildings. These plans represent the results of the investigations of Prof. S. Homer Woodbridge, of the Massachusetts Institute of Technology, as expert to determine the advisability of such central station. The buildings to which it is proposed to supply light, heat and power from a central station are those situated south of Pennsylvania Avenue and between Seventh and Seventeenth Streets, and include the following: State, War and Navy, White House, Treasury, Post Office, Winder Building, Bureau of Engraving and Printing, Smithsonian Institution group, Medical Museum and the Washington Monument. The new Municipal, Agricultural and National Museum are projected buildings also included in the plan. (See Fig. 1.)

In view of the lack of adaptability of the alternating-current motor to elevator and certain other classes of service, and the fact that

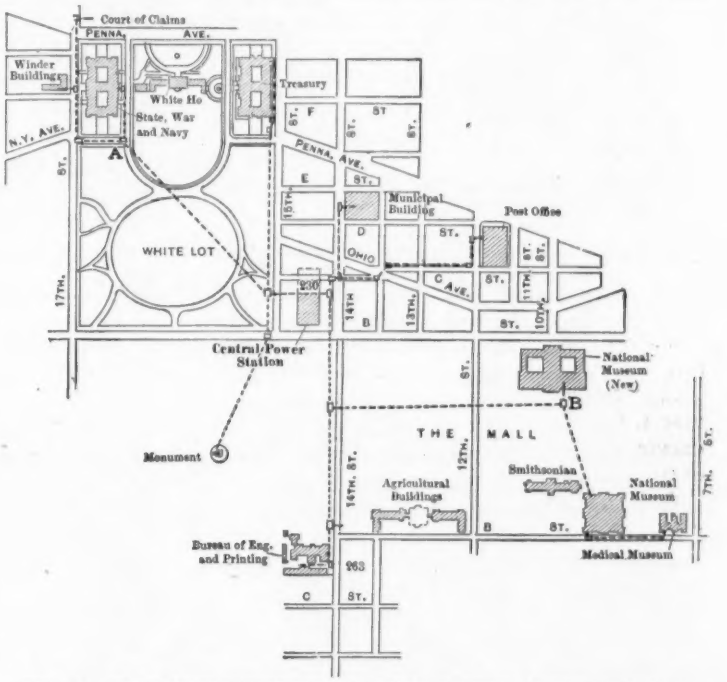


FIG. 1.—ELECTRICAL DISTRIBUTION FROM CENTRAL POWER STATION.

the adoption of alternating current for power service will necessitate the replacement of all direct-current motors now in service, and will require extensive changes in interior wiring, the use of direct current for all power purposes appeared the most feasible and best solution of the problem. It is shown that by installing a storage battery at a cost of $120,000 for the purpose of assisting during the peak load, a saving of 950 kw in generating capacity is expected. The increased reliability, reduction of fluctuation in steam generation, vital alike to economy and smoke prevention, together with the general improvement in quality of service and means afforded for the station regulation of voltage on feeder lines of various lengths and condition of loading, appear to fully warrant the required investment for the battery. The diagram, Fig. 2, indicates the use of the battery in cutting down the peak of the maximum daily output, while the rectangular cross-hatched portion shows the capacity of the battery at the one-hour rate of discharge.

It is proposed that, for the purpose of thermal transmission, hot water be driven through pipes by centrifugal pumps, the cost of operating the pumps being negligible, since all the heat of the steam used in driving of pumps to impell water motion may be given to the water moved, and the energy of water motion itself is finally transformed into heat within the water. It is advised that the water be circulated in such manner that in the coldest weather it shall lose not more than 30° F. in temperature in complete circuit, and that the ratio of the length of time the water may be retained in the buildings to that it shall be in traversing the pipes shall be made as large as practicable.

The report shows the following economies and advantages, namely: (1) By combining the buildings of the executive group in one system

of heating, power and lighting service, more than 70 boilers, now operated at some 26 different points, would be reduced to 10 boilers located in one room. Instead of being various in form, power and efficiency, these would be uniform in type and size and of high efficiency.

(2) The coal burned would be low-priced and of high thermal value and without the waste or nuisance of smoke and materially less in quantity than the high-priced anthracite of lower calorific

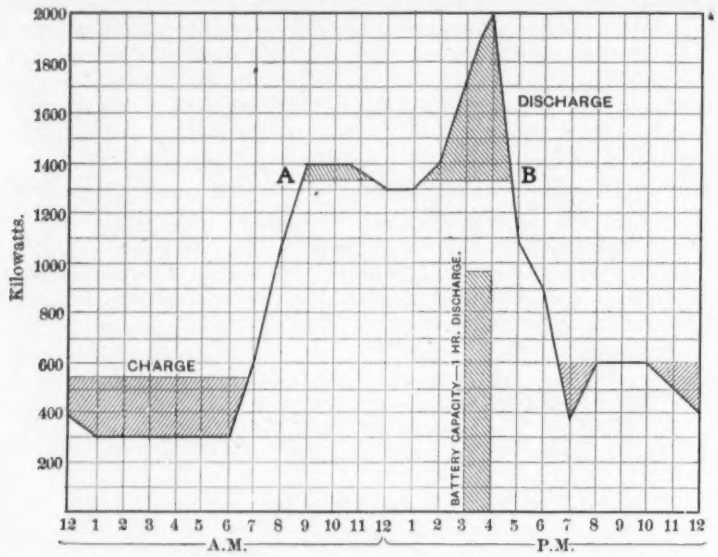


FIG. 2.—STATION LOAD DIAGRAM, SHOWING OPERATION OF BATTERY.

power, now burned chiefly to avoid the inevitable dirt and smoke attending the combustion of soft coal under the present conditions.

(3) The use of economizers and superheaters, more applicable to large and steady running plants than to small and unevenly running plants, would add to the economy of operation.

(4) The use of all exhaust steam for nearly two-thirds of the year for heating purposes would remove the principal cost of production of power during the heating period, and render the surplus of steam used for power in one building available for heating another.

(5) The use of condensing engines of high grade and economy would produce energy for power and lighting at reduced cost in the warmer months.

(6) The storage battery would serve to even the work of the boilers and engines, to remove the chief occasion for smoke and to reduce the night work of the plant and therefore the night force of the men.

(7) The electric service of power and light now purchased would be done away with for the Treasury, Winder, Court of Claims, Agricultural, Smithsonian group, Army, Medical Museum and other

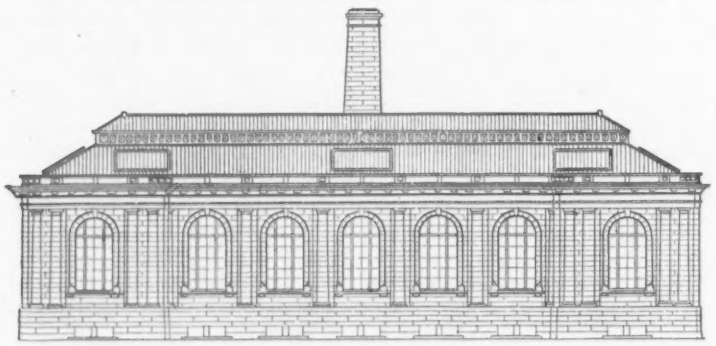


FIG. 3.—SIDE ELEVATION, CENTRAL POWER STATION.

minor buildings, through its cheaper production at the central station.

(8) The compacting of the isolated plants and the use of modern labor-saving devices, more economically applicable to large boiler and engine installations, would reduce the necessary number and cost of personal attendants to less than half that required by the buildings separately manned.

(9) The space vacated in buildings by the present boilers, generating engines and accessories, coal bunkers, etc., and made useful for storage and other purposes, would aggregate 600,000 cu. ft., or a space equivalent to 170 ft. square by 20 ft. high. Such an amount of space costs, in usual Government building construction, more than $100,000.

(10) All heat, dust, noise, gases, smoke nuisance and such danger as attends high-pressure steam production in the buildings, would be avoided.

(11) By proper construction and operation of such a plant the economy of the use of soft coal could be depended upon with practical freedom from smoke at all times.

(12) Hot water circulation direct from the power house proves not only better adapted to most of the heating apparatus of existing buildings, but far more economical and practical for transmission to them from the central station. The one or two buildings now fitted for steam instead of hot water heating, being fortunately near to the proposed central station, can be furnished with steam. It would, however, be better in every way if they contained hot water fixtures.

(13) A direct instead of an alternating electric current for lighting and power proves the more economical and conforms to the current for which the several buildings are already wired and equipped.

(14) The annual profits accruing from such a centralized plant and service are estimated at about 11.5 per cent. on the investment. In other words, the plant may be expected to repay its first cost within ten years after it is put into operation. Including the probable cost of the ground, the profits would repay the first cost in thirteen years.

(15) In round numbers the gross cost of the central station and plant, exclusive of the land, would be $1,400,000. Deducting from

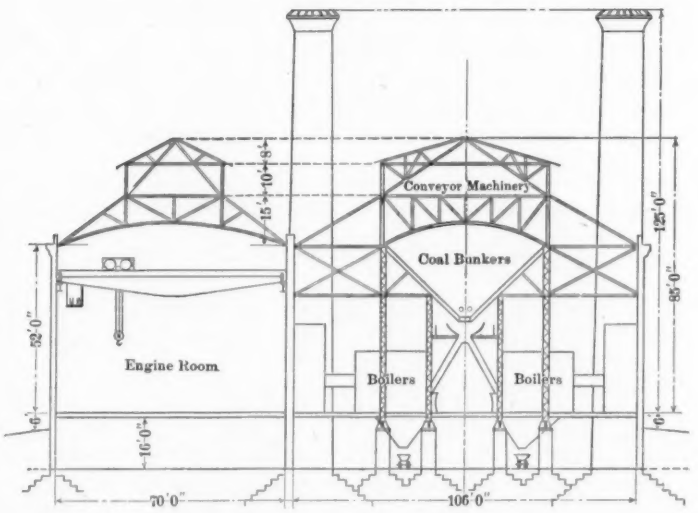


FIG. 4.—CROSS-SECTION CENTRAL POWER STATION.

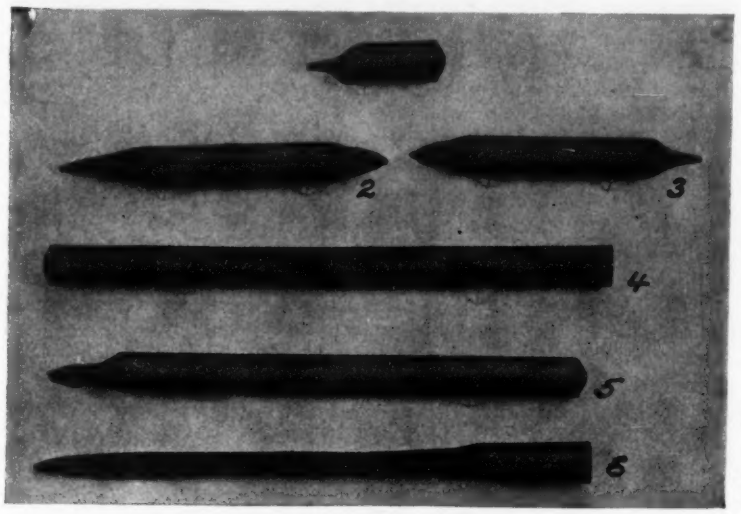
this the value of the extra size of the power house (at least $150,000) and the saving of steam and generating plants in the three buildings now going up, namely, the Agricultural, Municipal and the National Museum Buildings (say $182,000), the net cost of the proposed central plant for immediate needs would be $1,068,000.

On account of the close proximity of the central station to some of the principal Government buildings, the suggestion is made that it be designed to comport with the architecture which characterizes them. (See Figs. 3 and 4.) The station, performing so unique a service and equipped with the most modern and powerful apparatus, will doubtless be a continuously attractive object to visitors, and all its appointments and finishings should have reference to the educational service the chief national plant of this character might fittingly render.

All of the Government buildings, including not only those above considered for the heating and power service, but the Capitol and all others in the city, are now wired and provided with all necessary telephones and local switchboards, although these are at present the property of the local private company. It is proposed that these be purchased and that an independent telephone system be installed with the central in connection with and within the new power house. By connecting the switchboard of the Government central station with cables to the local company and providing for the transmission of outside and long-distance calls on some tariff basis, the entire service would be complete and equal to the present service.

Some Results with Arc Light Carbons.

The manager of one of the large central stations in the Southern States has sent us a photograph from which the accompanying illustration is made, showing some arc light carbons of poor quality. Those marked 1, 2 and 3 in the illustration were found to have been burnt off and were lying in the bottom of the globes. Owing presumably to high resistance in a portion of the carbon, an over-heating



ARC LIGHT CARBONS.

effect occurred which caused a burning or disintegration. A constant wearing away of a section of the carbon ensued. This section then dropped out and the arc "picked up" at the new exposed surface. Carbons 5 and 6 show this wasting away in another manner. In both cases the carbon, as will be observed, burned at the tip. Carbon 4 is a non-conductor, and our correspondent informs us that no amount of scraping the surface would cause, or allow, sufficient current to flow to pick up the arc.

The Early Days of American Electric Traction.

BY STEPHEN D. FIELD.

PERHAPS this is an opportune moment to present a few facts regarding the development of electric traction in the United States, which have apparently been generally overlooked. In the development of all great advances in the world's progress there comes a time when some one man adds a connecting link to the accumulated work of others which at once transforms a bundle of theories into a commercial success. It may be that the conduit railway wherein the working conductor is insulated mechanically as well as electrically will be considered by future generations as indicating a pronounced departure in practical lines. This was recorded in the United States Patent Office in the spring of 1880 as the sequence of a caviat filed a year earlier. The application showed a conduit, a trolley pole and trolley running on the under side of the working conductor, circuit controller on the vehicle and generating station. Among other contributions which I have made to the art of electric traction are: The detachable controller handle, universally employed, United States patent filed July 3, 1880. The first soldered and protected rail bond, filed July 16, 1882. The first rotary transformer, filed August 5, 1882. In my telegraph patent filed July 31, 1886, will be found the principle of a bipolar motor. This was reduced to practice and worked on the lines of the Mutual Union Telegraph Company in 1883.

The first direct-coupled motor was used by me on the New York Elevated Railroad, the application for patent on which was filed December 9, 1886. This patent shows interlocking devices between the current reverser and speed controller, also many other mechanical details which I take it will be found valuable in the near future.

The first feeder system connected with detached sections of working conductor will be found in my patent of November 20, 1888, filed April 5, 1884.

In 1882 I submitted to the New York Elevated Railroad Company a plan for the electrification of their system, said plan embraced double and guarded working conductors, also the employment of a potential of 600 volts.

LETTER TO THE EDITORS.

Lighting at Atlanta, Ga.

To the Editors of Electrical World and Engineer:

SIRS:—On page 138 of the ELECTRICAL WORLD AND ENGINEER under date of January 21, 1905, you made reference to a report by the city electrician of this city giving statement of the lamps, etc., in this city. The way this article reads would indicate that the figures given cover the entire connected load, but I think they were only supposed to show the number of lamps wired during the year 1904. As this would probably give a wrong impression, I would be glad if you would correct the statement, and for this purpose I desire to say that our commercial connected load on January 1, 1905, was 3,600 hp in motors, 1,372 arc lamps and 93,016 16-cp lamp equivalents.

ATLANTA, GA. GEORGIA RAILWAY & ELECTRIC CO.,
By G. W. Brine.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Coils and Ozone.—MEYER.—A communication with respect to the recent article of Highfield. He gives a record of the way the General Electric Company of this country handled the problem of finding a suitable insulation for high-voltage alternating-current generators. To avoid the detrimental effects of nitric acid produced by the brush discharges, mica tube insulation was discarded, and it was resolved to use a winding in which all moisture could be driven out by a vacuum process, and the interstices of the coil completely filled with an asphalt compound which would be solid at the running temperatures of the machine. This filling, in addition to preventing the accumulation of moisture inside the coil through the movement of the air caused by the variation in temperature, also serves to conduct the heat out of the coil at a much faster rate than if air was present, and therefore leads to a lower temperature of the winding. The coils thus filled are covered with a number of layers of tape, each treated in such a manner that a glaze of oxidized oil which is formed is practically infusible, and which acts as a permanent seal to the fibres of the tape. The finished coils are entirely moisture-proof, remaining at the same time sufficiently flexible to lend themselves readily to bending and clamping, so that vibrations or severe strains, such as may be caused by wrong paralleling or short-circuits of the system, have hardly any effect.—Lond. *Elec.*, February 3.

Transformer Oil.—SKINNER.—An article giving some hints on transformer oil. Transformer cases, before being filled with oil, should be thoroughly dried, and care should be taken that water will not find its way into the case through faulty bushings or lack of proper precautions in closing up the case. The author describes a method for finding out whether water is in the bottom of the case if its presence is there suspected. He distinguishes between water and moisture and describes the precautions to be taken with water-cooled transformers and the special precautions necessary with very high-tension transformers. To test oil for moisture, the dielectric test is the most satisfactory. This test is made by means of a high-potential transformer and a testing cup, which is shown in Fig. 1. This device consists of a 200 cu. cm. graduated glass vessel 1⅜ in. inside diameter, with a hole drilled through the bottom, through which the lower terminal is inserted. The testing terminals consist of two brass balls ½ in. in diameter, fastened to 3/16-in. rods. The upper rod passes through a clamp, which is connected to a micro-

meter screw actuated by a milled head. The apparatus is always filled to the 200 cu. cm. mark (requiring a little less than 200 cu. cm. of oil for each test). When a sample of oil is to be tested the spark-gap in the cup is adjusted to a convenient size, usually 0.15 in., and

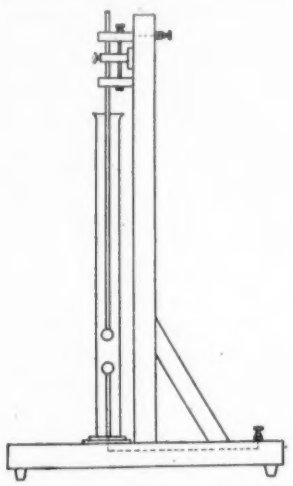


FIG. I.—TESTING CUP.

the voltage raised gradually till breakdown occurs. Dry oil should stand a test of at least 20,000 volts and oil is frequently found which will stand 25,000 to 33,000 volts.—*Elec. Club Jour.*, February.

Water-Proofing Compounds in Transformers.—A note on the action of water-proofing compounds. In many transformers water-proofing compounds are used which may or may not be soluble in the oil in which the transformer is immersed. These water-proofing compounds are necessarily good insulators. The materials used may have either an asphalt, coal tar or linseed oil base. The action of the various types of compounds is described in general.—*Elec. Club Jour.*, February.

Repulsion Motors.—BLONDEL.—An article on the revolving field of repulsion motors. The author considers as one of the great advantages of repulsion motors that they facilitate commutation on account of the production of a more or less perfect revolving field produced by the combination of the primary and secondary fields. The revolving field is, however, strictly circular only under the following conditions: operation at synchronism and negligible ohmic resistance of the secondary circuit. The theory is given by means of diagrams.—*L'Eclairage Elec.*, January 14.

Heyland Diagram.—KARAPETOFF.—The conclusion of his illustrated serial on applications of alternating-current diagrams. He gives a fully illustrated explanation of the construction of the Heyland diagram for induction motors, his explanation being illustrated by an application to the case of a two-phase, 60-cycle, 200-volt, 5-hp induction motor.—*Elec. Club Jour.*, February.

Armature Winding.—A fully illustrated article on the design and construction of various types of armature windings for constant-potential, direct-current machinery.—*Elec. Club Jour.*, February.

Drying Out Magnet Coils.—ARTHUR.—An illustrated article containing many practical suggestions on the drying out of armature coils with the use of a water rheostat.—*Am. Elec.*, February.

Principles of Electrical Apparatus.—A didactic article with diagrams, treating of the feature of self-induction in the rotor of an induction motor.—*Am. Elec.*, February.

Resistance Regulation of Motors.—HAHN.—An article giving formulas on the influence of resistance regulation on the torque and efficiency of direct-current and polyphase motors.—*Elek. Anz.*, February 5.

LIGHTS AND LIGHTING.

110-*Volt Osmium Lamp.*—BLAU.—An abstract of a Berlin Electrical Society paper on the osmium lamp. The author first gives some general considerations on filaments suitable for incandescent lamps. "Black substances, like carbon, are very unfavorable for the economical production of light, in contradistinction to bright metals like platinum. An incandescent filament which shall fulfill the requirements of theory and practice must have the following properties: Its radiating surface should be as little black as possible. The substance of the filament, when cold, should be as transparent as possible, or white. During use the surface should not become blacker or rougher, but rather less black and more smooth. Reversely, according to the theory, the interior of any incandescent filament must behave exactly like a black body. Bodies which contain empty spaces are, therefore, more like black bodies in the sense of the theory of radiation, and the rough substance is, therefore, more black than a smooth one in this sense." The author showed that the osmium lamp fulfills these requirements of the theory in high degree. In contradistinction to lamps with a filament, made of a drawn metal wire, the osmium filament consists of fine porous osmium of great density and has a surface which under the microscope shows numerous small pores. The osmium lamp has a very long life without a corresponding decrease of candle-power. Some lamps tested had a life of up to 5,000 hours. "At 1.5 watts per cp the osmium filament is only moderately loaded with respect to its resistivity." At the beginning of its life the osmium filament is not yet definitely formed. The surface of the filament is not smooth and a petrifying process is going on during the first hundred hours or more, so that during this time the filament improves and the candle-power increases. This advantage is due to the fact that the osmium filament is not made of a drawn wire but of osmium particles coagulated together. The first osmium lamps were made for 27 volts, later on lamps for 37, 45 and 55 volts were made. The author exhibited the very latest type which is for 110 volts. 110-volt lamps have already been used in the workshops and offices of the German Incandescent Gas Light Company (which owns the osmium lamp patents) and are stated to have been proven perfectly satisfactory.—*Zeit. f. Beleucht.*—January 30.

110 *Versus* 220-*Volt Lamps.*—A note stating that at the request of the commission which has under consideration the future electricity supply of Paris, laboratory tests have been made under the direction of Janet with lamps of 5, 10 and 16 cp, furnished by five different manufacturers. The tests which were made at constant potential have shown that 110-volt lamps consume at start 3.6 watts per candle and after 200 hours 3.87 watts per candle, while 220-volt lamps consume at start 4.4 watts per candle and after 200 hours 5.19 watts per candle. The specific energy consumption, therefore, increased during the first 200 hours by 7 per cent. for 110-volt lamps and by 18 per cent. for 220-volt lamps. The 220-volt lamps have at the beginning a 20 per cent. higher specific energy consumption, and after 200 hours a 34 per cent. higher energy consumption, than 110-volt lamps. The price of the lamps varies from 8 to 12 cents for 110 volts, and from 15 to 20 cents for 220 volts. The conclusion is that in every respect 110-volt lamps are superior to 220-volt lamps as made at present.—*L'Industrie Elec.*, January 25.

POWER.

Variable-Speed Motors.—SUMPTER.—An article in which the author first discusses the relative advantages of simple variable-speed motors (with a speed range of say 300 to 900 r.p.m.) and of multiple-voltage systems and double-commutator motors. For machine tool driving, where the power required is practically constant at all speeds, the single-voltage, variable-speed motor is no more expensive than the double-voltage (the extra output at the higher speeds of the double-voltage motor being of no advantage), while the single-voltage motor has all the advantages of simplicity and the great saving in the cost of the controller and wiring. The double-voltage or double-commutator motor, which is very similar, is especially suitable for driving rolling mills, etc., where the load is intermittent and heavy. Of course, a greater speed range is possible on these systems, but if the voltage of the supply is kept down below 250 volts there is not any difficulty in designing a variable-speed motor with a range of four or even six to one, which, since most machine drives are through gearing, is as great a range as should be adopted, granted that it is not economical to make motors of a slower initial speed than about 200 or 300 r.p.m. He refers to a method of Williamson of using the simple variable-speed motor for driving reciprocating machine tools. A portable vertical planer or slotting machine is driven by a 5-hp motor with a range of speed from 300 to 900, the motor being attached directly to the machine. On the cutting stroke the motor runs at its slow speed, and at the end of the stroke, the length of which is easily adjusted to suit the work, the motor reverses automatically. As soon as the reversal has occurred a resistance is automatically inserted in the field winding, quickly raising the speed to 900 for the return stroke. At the end of the quick return stroke, immediately before reversal, the field resistance is short-circuited, providing a strong field for reversing

it, and the motor reverses and makes its slow cutting stroke, the cycle repeating itself. This method has been tried with great success on some very heavy planing machines, the motor driving the table direct through a single gear, all belts, pulleys and almost the whole of the gearing of the machine being done away with. The author points out other advantages of such methods. He concludes with the following statement: If a considerable number of long-range, variable-speed motors are to be installed, the voltage of the supply should be kept low, so that the use of all double-voltage and double-commutator machines, with their extra cost and complications, is avoided. When the motors are ordered, it should be specified if they are not required to do full load at the low speeds, or if they are only required to work at the low speeds intermittently, as, in these cases, the price can be very considerably reduced.—Lond. *Elec.*, January 27.

Electric Hoist at a French Colliery.—An illustrated description of an electric hoist recently installed at the Lallemande Colliery intended to raise 105 tons per hour from a depth of 1,412 ft. at an average speed of 26 ft. per second. The general mechanical arrangements and the application of the Koepe pulley are described. At starting the maximum effort is about 600 hp, decreasing to 300 hp during the cage trip, and to nothing at the stops. To nullify the effect of these fluctuations at the primary station, a buffer set of motors has been installed at the central, this set assisting at starting, governing the main engine, and equalizing the load on the generating station, so that the latter is only called on to supply a constant power of about 300 hp. This buffer set is constructed according to a Lahmeyer method and consists of a starting dynamo, *A* (Fig. 2), a

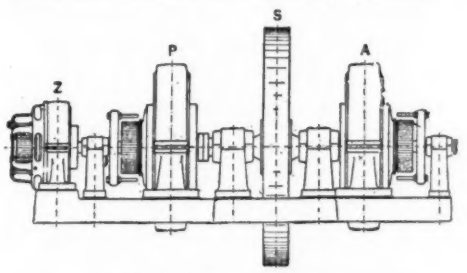


FIG. 2.—ELECTRIC HOIST.

buffer motor, *P*, and a supplementary motor, *Z*, all three being mounted on a common shaft, which also carries a fly-wheel, *S*. When the hoisting motors are at rest the starting dynamo, which is in series with the circuit, develops the same voltage as the primary station, but in an opposite direction, the consequence being that the voltage at the terminals of the winding motors is reduced to zero. At the moment of starting the cages the excitation of the starting dynamo is lessened, so that the tension at the terminals of the winding motors is increased, and the latter begin to run, their speed increasing in proportion as the excitation of the starting dynamo diminishes. When this voltage has been reduced to zero, the velocity of the rope attains to half its normal value. From this point onward the excitation of the starting dynamo is reversed, its voltage begins to supplement that of the circuit, and in this manner the total voltage is raised to 1,050 volts (525 volts for each motor), whereupon the velocity of the hoisting rope attains the maximum. The governing is thus entirely effected in the excitation circuit of the starting dynamo; that is to say, in a circuit traversed by a current of insignificant intensity. The regulator, with its resistance, takes the form of a controller, and is mounted on the lower stage of the head frame. It is actuated by the starting lever on the upper stage. As already mentioned, the starting dynamo is actuated by a buffer motor, coupled up with the primary station circuit in the ordinary manner. The supplementary motor, *Z*, is in series with the buffer motor, and is fitted with a regulator in its excitation circuit. When the voltage of this latter motor supplements the voltage of the main circuit, the tension at the terminals of the buffer motor increases, and, consequently, this motor runs at an increased speed. If, on the other hand, the voltage of the supplementary motor is abstracted from that of the main circuit, the speed of the buffer motor is reduced. Intermediate speeds are obtained by setting the regulator accordingly, and by this means it is possible to vary the speed of the motor, and consequently of the buffer set, by 30 per cent. The buffer set is fitted with a fly-wheel, so that when the speed is reduced the energy in the fly-wheel will be liberated in aid of the primary station, and vice versa. The regulator already mentioned is rendered automatic by the provision of an electromagnet traversed by the entire current flowing from the central to the winding motors. When this current commences to increase, the regulator lowers the speed of the buffer group, and vice versa. This arrangement enables the energy of the fly-wheel to be brought into play, with the result that the load on the primary station remains constant, whatever the position of the winding motor. An electromechanical brake is provided for stopping the buffer set and acts automatically in the event of anything going wrong with the bearings of the buffer set.—*Eng'ing and Mining Jour.*, January 19.

Transmission Plant.—An illustrated article on the Caffaro hydroelectric plant for supplying electrical energy to the Province of Brescia. It contains at present three three-phase generators, each of 2,750 kilovolt-amp., the voltage being 9,000 to 10,500, the current 250 amp. and the frequency 42 periods per second. For excitation there are provided two direct-current machines driven by separate turbines. For transmission the voltage is increased to 46,000 by means of three transformers, each of 2,750 kilovolt-amp. In Brescia the voltage is reduced by three transformers to 3,600. The installation of two other generators and corresponding transformers is planned. A second power station of the same capacity is projected for a later time. The article gives descriptions of the machines and the results of tests.—*Elek. Zeit.*, January 26.

Power Distribution Plant.—An illustrated description of the power distribution system of the Louisville Railway Company. It is an extensive polyphase distribution system installed recently by the company for its own city lines as well as for suburban lines. There are three synchronous converter sub-stations.—*St. R'y Jour.*, February 11.

Engines at American Power Stations.—SAXON.—A paper read at the British Institution of Mechanical Engineers. The first part is descriptive and refers to the engines in large New York stations and the engines exhibited at St. Louis. The author says that the engineering section of the St. Louis exhibition proved to be rather disappointing after the visits made to the large power stations in New York. "These stations were constructed on an impressive scale, and give a far better idea than the exhibition of the ability and resources of American engineering to deal with the great power problems with which they are confronted, especially in such a city as New York." Without expressing any opinions as to the suitability and merits of the steam turbine versus the steam engine for power station work, he said that "the evolution in the development of the steam engine for this purpose has resulted in the introduction of a class of engine which is a compromise between the two well-known types, namely, the combined horizontal and vertical compound engine, known as the Manhattan type, because of its being first introduced in the Manhattan power station. This is a type which meets with his entire approval, for space occupied, for evenness of turning effort, for accessibility for overhauling and repairs, and for the placing of the cylinders to prevent undue wear; these and other advantages combined make this type unequalled for the special purpose. The application of the barometric type of condensers at the stations visited and at the exhibition was a proof that this condenser is giving excellent results." With regard to the finish of the engine exhibits, he says it did not quite come up to the standard of European exhibitions.—Lond. *Eng'ing*, February 3.

Boiler Manholes and Handholes.—STROHM.—An illustrated article describing the various types of manholes and handholes used in boilers.—*Am. Elec.*, February.

Turbo-Generator.—An illustrated article on the 5,500-kw turbogenerator in the Seventy-fourth Street Station of the Subway Company, New York, and its operation in parallel with slow-speed machines.—*Elec. Club Jour.*, February.

Pumps.—PERKINS.—An illustrated description of a number of electrically-driven pumping plants in Germany, England and America.—*Mines and Minerals*, February.

TRACTION.

Tramway Overhead Equipment.—SAYER.—A paper read before the Tramway and Light Railways Association, giving a concise summary of the present practice in tramway overhead equipment materials.—Lond. *Elec.*, January 20 and 27. The paper is also printed in abstract in *St. R'y Jour.*, February 4. An account of a discussion which followed the paper with some editorial notes on the subject. The differences in the practice of various countries in several points of detail were brought out in the discussion. Glass, for instance, which is

used to a considerable extent as a material for insulators in the United States, is unsuitable in the British climate, and the horn type of lightning arrester, which had been used with good results in South Africa, offers too wide a spark-gap for the comparatively mild thunderstorms at home. Considerable criticism was devoted to the standard sizes of tramway poles adopted last year by the British Engineering Standards Committee. The three sizes recommended by the committee for light, medium and heavy work, respectively, have diameters, at the base, of 7½ in., 8½ in. and 9½ in., while the minimum thickness of metal is specified at ¼ in. Lawson thought these poles too weak, and suggested increasing the diameters by ½ in. in each of the three cases. It is obvious, of course, that the most economical way to increase the strength of the pole is to increase its diameter—economical, that is to say, so far as expenditure of material is concerned—yet there are equally important reasons, mentioned by Fell, Sayers and Booth, why it is preferable to increase the strength, when this is necessary, by an augmentation of the thickness of metal. Booth raised the question of the bow collector versus the trolley, and although Sayers, in his reply, professed to know little about the former, he pointed out a new disadvantage, viz.: that the lubricating material, which is necessarily employed, would drop on the passengers riding on the double-deck cars, which are almost an essential feature of tramway practice in England.—Lond. *Elec.*, February 3.

Terre Haute.—A fully illustrated article on the street and interurban systems of Terre Haute, Ind., which promises to become the interurban center of Western Indiana. There are three separate power houses. A special feature is the recent installment of a 500-kw steam turbine.—*St. R'y Jour.*, February 4.

Brakes.—DEWSON.—In a continuation of his illustrated serial on electric railway braking he deals with the transmission gear of an air brake equipment.—*Elec. Club Jour.*, February.

Repair Shop.—A fully-illustrated description of the new repair shop plant of the Detroit United Railway, which represents a new departure in street railway shop plants. The building is especially designed for railway shop repair work and is the first attempt to adopt on a large scale the most advanced steam railroad practice to electric railway requirements.—*St. R'y Jour.*, February 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switchboard Connections of Compound-Wound Generators.—GASSMAN.—Judging from the number of mistakes that are made in connecting compound-wound generators to switchboards, the author is of the impression that few men have a clear understanding of the correct scheme of connections. He attributes this to the confusion caused by introducing the idea of polarity when speaking of the terminals of a generator. He finds it advantageous to drop the idea of polarity and speak of three leads running from the generator as equalizer, armature and series main. The armature main is the one running direct from the armature terminal to the switchboard, and the series main, the one running direct from the series coil. Whatever the polarity of the series main, the equalizer will be of the same polarity and the armature main of the opposite polarity.—*Am. Elec.*, February.

Oil for Oil Switches.—A note stating the different requirements of oil for oil switch and transformer work. The more fluid the oil for transformer work the more rapid will be the cooling action of the transformer on account of the more rapid circulation of the oil in the transformer tank. In switch work a more viscous oil seems to give better results, possibly on account of the fact that it is not so easily displaced by the arc as is the lighter oil. Otherwise the requirements are exactly the same for both transformer and switch work. (See also the abstract on *Transformer Oil* under "Dynamos, Motors and Transformers.)—*Elec. Club Jour.*, February.

WIRES, WIRING AND CONDUITS.

Aluminum.—SMITH.—An illustrated paper giving some brief notes on the production and different uses of aluminum. The author discusses at some length the uses of aluminum as an electric conductor and the method of joining aluminum wires. Some micrographs are reproduced.—Lond. *Elec. Engineer*, January 27.

Cables.—An illustrated article giving practical hints on cable splicing.—*Elec. Club Jour.*, February.

Wiring in Stables.—SCHWARZ.—An article pointing out the necessity of using the best installation materials for such purposes.—*Elek. Anz.*, February 5.

ELECTROPHYSICS AND MAGNETISM.

Thermo-Electricity.—HALL.—A paper presented before the American Association for the Advancement of Science, offering "a tentative theory of thermo-electric action." Some of the assumptions made by the author are as follows: Electricity within a metal acts like an expansible fluid, and the rise of temperature which causes the expansion of the electricity absorbs heat. He assumes that there is a real thermal capacity of electricity, or of the corpuscles moving with it. The attraction which exists between metal and electricity holds the electricity within the metal in a state of pressure, and accordingly the author recognizes in the thermal capacity of the electricity a part accomplished against this pressure in the expansion which accompanies rise of temperature. At the prevailing thermo-junction across which each kind of electricity flows, from the metal by which its kind is attracted less, to the metal by which its kind is attracted more, that is, from a place where the pressure caused by the attraction is less to a place where the pressure caused by the attraction is more, each kind of electricity will, without change of temperature, suffer contraction of volume in the transition and evolution of heat will result. On the other hand, at the other junction, where each kind of electricity moves, without change of temperature, from a place of high attractive pressure to a place of low attractive pressure, each kind will expand in the transit, and absorption of heat will accompany this expansion. Finally, for thermo-dynamical reasons, the author supposes that electricity in its state of compression within a metal obeys the law of a perfect gas.—*Science*, January 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Lightning Recorder.—ALCIATORE.—A description of a simple, effective and inexpensive lightning recorder which has proven fairly satisfactory at the weather bureau in New Orleans. The construction is shown in Fig. 3 in which *d* is a double connector, *B* batteries

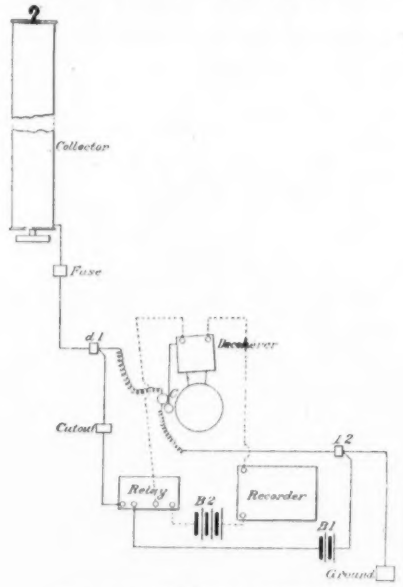


FIG. 3.—LIGHTNING RECORDER.

and *C* a coherer. The collector is a hollow cylinder, 14 ft. long and 11 in. in diameter, made of two sheets of commercial zinc nailed to three discs of wood, one at each end and the third in the middle. The edges of the zincs are soldered. The coherer consists of a piece of thick glass tube one-quarter inch inside diameter, two inches long, into which are closely fitted two silver electrodes, each one-quarter inch in diameter and three-eighths of an inch long, with a piece of copper wire soldered to each. The electrodes are about one-sixteenth of an inch apart. In the space between them are placed a few coarse silver filings. The decoherer is an ordinary 3½-in. door-bell, to the hammer of which is soldered a stout piece of wire two inches long, at right angles with the axis of the hammer, and to which the coherer is attached by means of insulating tape. When the bell rings the filings are shaken and separated. The relay is of the ordinary kind used in telegraphy and has a resistance of about 150 ohms. The fuse is an ordinary 2-amp. fuse. The recorder con-

sists of a strong clockwork, a hollow wooden cylinder 3¼ in. in diameter and 3¼ in. long, mounted on an endless screw fixed to an upright iron support at one end; and a small doorbell magnet on whose armature is soldered a self-inking pen made of a hollow brass cone about one-quarter of an inch in diameter at the base and one inch long. The cylinder carries a sheet of paper divided into hour and five-minute spaces and makes a complete revolution once every hour. A fresh sheet is placed upon the cylinder every twenty-four hours. Every time the recorder ticks the pen, which is suspended over the cylinder about one-sixteenth of an inch therefrom, strikes the paper and imprints thereon a dot. The whole cost is about $30. The collector is on the roof of the building; the rest of the apparatus is in the office room. Where written signals are not required, the bell on the decoherer can be utilized for giving double signals, and the cost of the apparatus greatly reduced.—*Monthly Weather Review* (U. S. Dept. Agr., Weather Bureau) November, 1904.

Phantom Telephone Circuit.—ROBINSON.—An illustrated article describing the phantom telephone circuit which is customarily installed between telephone exchanges having considerable toll business. Repeating coils are placed in trunks and taps are taken out of the middle of the line side of each. These taps are connected to one-half of the secondary of a double-wound induction coil and compound receiver. A double-wound head telephone is connected to two plugs which go into jacks. One winding of the receiver is in the phantom circuit at all times and the distant operator has only to press her button switch in order to carry on a conversation. With ring-down phantoms it is not necessary to have the special double induction coils and receivers, as the phantom is carried to jacks and drops on the board. When the phantom is not in use the coils are cut out and the trunks cut straight through in the ordinary manner.—*Am. Elec.*, February.

Telegraphy and Telephony in Germany.—A statistical article on the development of telegraphy and telephony in Germany during 1903. There were at the end of 1903 in Germany 23,562 telegraph stations against 22,267 in 1902. The total length of the telegraph and the telephone lines were 215,806 km. in 1903, against 203,970 in 1902; the total length of telegraph and telephone conductors was 2,021,176 km. in 1903, against 1,710,475 in 1902. There were transmitted in 1903 a total of 831,588,504 telephonic messages against 757,648,580 in 1902, while the number of telegrams transmitted in 1903 was 34,221,405, with an average length of 13.03 words.—*Elek. Zeit.*, January 26.

Wireless Telegraphy.—PRASCH.—An illustrated summary of various improvements made in recent years in wireless telegraphy operation.—*Dingler's Polytech. Jour.*, February 4.

MISCELLANEOUS.

Electric Baker's Oven.—KREJZA.—An illustrated article on an electric oven recently installed in a baker's shop in Bregenz. Below each of the two doors there are ten switches by which various portions of the heating wire may be switched in and out for regulating the temperature. The advantages are absolute cleanliness, very simple in operation, saving in wages and easy control. This oven is daily in use from 4 a.m. to noon. In this time the baker bakes as much as formerly in the time from 4 a.m. to 6 p.m. The output in this time is about 850 kg., the average power consumption being 14.27 kw. This power is consumed during a time when the central station has a very small load, so that it sells the energy at a very low rate. According to the statements made to the writer at his visit to the plant the cost of the kw-year is not more than $20 for the rational operation of the oven.—*Zeit. f. Elek.* (Vienna), January 29.

Danger to Firemen from Throwing Water on Electric Wires.—A note stating that according to Berlin daily newspapers a fireman holding the nozzle of a hose received an electric shock because he threw water on a wire carrying current. It was also stated that the fire chief of Berlin has decided to replace the metallic hose nozzles by such covered with rubber. The present writer states that these statements are all wrong. The fireman got a shock because he stepped on two wires and almost simultaneously he touched with an iron hook another wire. The fire chief does not intend to introduce rubber-covered nozzles. Several references to notes in technical journals are given to prove that there is almost no danger to firemen holding the hose.—*Elek. Zeit.*, February 2.

Patterns.—WATSON.—An illustrated paper read before the Rugby Engineering Society on methods of pattern making, and especially on modern practice with wood patterns.—Lond. *Elec.*, February 10.

BOOK REVIEWS.

MANUALE PRATICO PER L'OPERAIO ELETTROTECNICO. By G. Marchi. Milan: Ulrico Hoepli. 337 pages, 189 illustrations. Price, 2.50 lire.

The author of this little volume has endeavored to give a general outline of the elementary and arithmetical theory of operation of electrotechnical apparatus and systems suitable for the use of electrical artisans, elementary students and those who are interested in the behavior of electrical apparatus.

The treatment is clear and simple, the quantitative relations of the subjects considered being expressed arithmetically as a general rule, so that but little mathematical knowledge is required from the reader. Nevertheless, the book is effective in covering a considerable range of study.

The diagrams are clear and readily understood, but the cuts are poor from the standpoint of modern illustrative art. There are also a number of typographical errors in the text that should be removed in the next edition. The general subjects treated are batteries, electrolysis, electromagnetism, bells, telephones, electromagnets, measuring instruments, dynamos, motors, storage cells, alternating currents, polyphase currents, alternating-current motors, transformers, electric distribution, central stations, installations and high-frequency currents. The book should well fulfil its purpose. It would be materially improved by an index of contents.

LES ACCUMULATEURS ELECTRIQUES. By L. Jumau. Paris: V. Ch. Dunod. 926 pages, 594 illustrations. Price, 27.50 francs.

This is probably the most complete single work on the storage battery ever written. In it are covered all the theories on the various types of accumulators, both lead and the other varieties which have had their fitful day and then disappeared; the methods of preparation and manufacture, testing, auxiliary apparatus and numerous applications, including traction, automobiles, navigation, train lighting, aerostatics and ignition.

From the fact that it contains nearly a thousand pages of large size, the scope of this volume may be partly conceived. The treatment is in most cases clear and thorough, particularly that portion relating to the theory and the description of the various types of plates. Of course, it is impossible to put into a single volume the aggregate data contained in several special treatises, but so far as this is practicable M. Jumau has done it.

There is more on the fabrication of plates in Schoop's "Die Akkumulatoren"; more on the evolution of types and designs and descriptive matter in Wade's "Secondary Batteries," and more on the engineering applications and auxiliaries in Lyndon's "Storage Battery Engineering," but no author has before so completely gathered the most important features of each of these special subjects in one single volume. The scope of the work is encyclopædic and forms a most valuable reference book. It is more than a pity that such useful and extensive data should have their value greatly diminished by the absence of any index. The table of contents is fairly complete, but this is not sufficient for a busy engineer, and certain subjects might be treated under any one of several headings. It is to be hoped that the next edition and any translation of this book will be provided with a comprehensive index.

The Svea Caloric Engine.

BY G. EMIL HESSE.

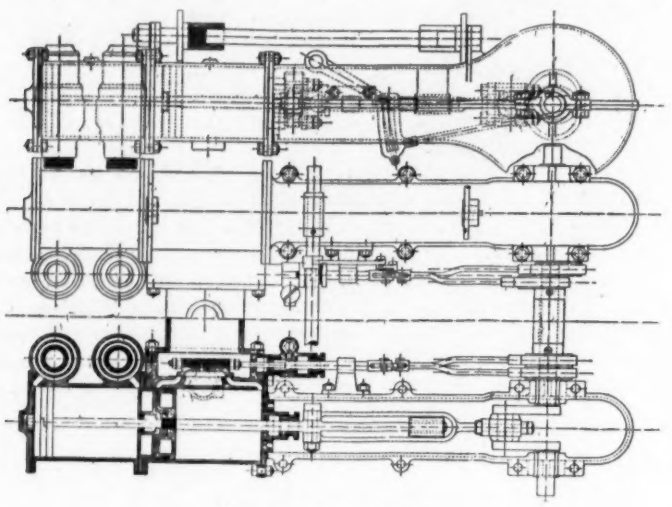
The principle of the Svea hot-air engine differs radically from the older types. A volume of cool air, split up into thin sheets, passes over heated plates at a velocity which is under absolute control, absorbing on its way the heat radiated from the plates. The Svea Caloric Engine Company is now building a 6-hp hot-air engine, applicable to launches, automobiles, etc., and has under way a 100-hp stationary engine.

The 6-hp engine has a cylinder diameter of 4¼ in., a stroke of 4⅞ in., and makes 450 r.p.m. It is double-acting, self-starting, reversible and under perfect control, which makes it applicable for electric lighting and general power purposes. The heater is 20 in. in diameter and 16 in. long, with a heating surface of 60 sq. ft.

It is well known that one gas is as good as another for the con-

version of heat into power. Air, steam, carbonic gas or any other gas can be used if desired, but the two first mentioned are the only gases which can be had free of cost, although in many instances feed water for the boilers has to be paid for. The New York Edison Illuminating Company, for instance, pays over $100,000 a year for the water used in its boilers. Air, however, is free under all conditions and never fails.

The heat required to change 1 kg. of air from 10° C. to 100° C. is $90 \times 0.24 = 21.6$ thermal units. The same weight of steam requires $90 + 537 = 627$ thermal units. The two gases are now on



6-HP CALORIC ENGINE.

an equal basis and ready to be superheated. If the feed water is heated to 90° and the steam is condensed, a saving of

$$80 + \frac{10{,}334 \times 1.649}{424\left(\frac{10}{9} - 1\right)}\left[1 - \left(\frac{1.649}{14.55}\right)^{\frac{1}{9}}\right] = 155.8 \text{ units}$$

is effected, making the net expenditure $627 - 156 = 471$ heat units, as compared with 21 units for air. It is for this reason that both the internal and external combustion engine is so much more economical than the steam engine.

Induction Integrating Wattmeters.

In a paper read before the second annual meeting of the Colorado Electric Light, Power and Railway Association, Mr. A. A. Serva discussed some interesting facts relating to the essential elements of the induction integrating wattmeter, as illustrated in the meters of the Fort Wayne Electric Works. The induction wattmeter consists of a combination of series and shunt elements (Fig. 1) establishing a rotating field which produces opposing fields by inducing current in a movable closed secondary causing the rotation of the same. It is, of course, obvious that the speed must be proportional to the wattage to be measured. In order for this to hold true, the combination of elements above referred to must produce a torque directly proportional to the load or wattage. This is accomplished by causing the rotating element, which is constructed of non-magnetic, but current-conducting material, to pass between the poles of permanent magnets which generate eddy currents in it directly proportional to the speed. (See Fig. 7.)

Of the many conditions to be met in actual service which must be carefully considered the more important are: (1) Varying load, (2) varying voltage, (3) varying frequency, (4) varying wave form, (5) varying power factor, (6) any combination of the above. In regard to wave form, most modern meters are practically accurate within the required limits which are usually met in practice.

One of the most important features in connection with wattmeter work is accuracy on inductive loads, and it is evident that a meter must be constructed to take account of variation in power factor. This is accomplished by what is commonly termed in practice "lagging" or causing the fields due to the series and shunt elements to be displaced 90 electrical time degrees for non-inductive load and to create a torque proportional to *cos* Θ for all power factors.

Briefly, the method employed in lagging, what occurs in the meter when being lagged, its condition after lagging, and its action when placed in actual service, may be explained as follows: In Fig. 2 is shown the internal connections of a Type K single-phase induction integrating wattmeter with the series and shunt elements separately connected to two independent circuits, *A* and *B*. The elec-

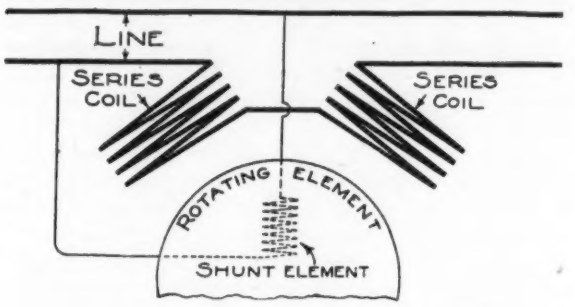


FIG. 1.—IDEAL CONNECTIONS OF WATTMETER.

tromotive force of circuit *B* is 90 electrical time degrees from that of circuit *A;* that is, the e.m.f's are in quadrature. Sufficient non-inductive load is placed on circuit *A* to cause the full load current at 140 cycles to flow through the series element, *C, C'*, and the normal e.m.f. of the meter is impressed on circuit *B*. The 140-cycle "lagging resistance" (*H*) is then adjusted until the rotating element remains stationary, giving a no-torque phase relation between the fields produced by the series and shunt elements. This result indicates that there is no revolving field at the moving disc, showing that the fields due to the shunt and the series elements are in unison (displaced 0° or 180°). Now, 90° of the displacement is due to the fixed phase difference between the e.m.f's impressed on circuits *A* and *B* (Fig. 2), the other 90° being due to the arrangement of the coils, etc., of the shunt element, as explained below.

Referring to Fig. 3, let *O X* represent the phase position of the flux, due to the current in the series elements, *C, C'* (Fig. 2), when the current is in phase with the e.m.f. impressed on circuit *B*, and let *O Y* represent a phase position 90° from *O X*. *O S* represents

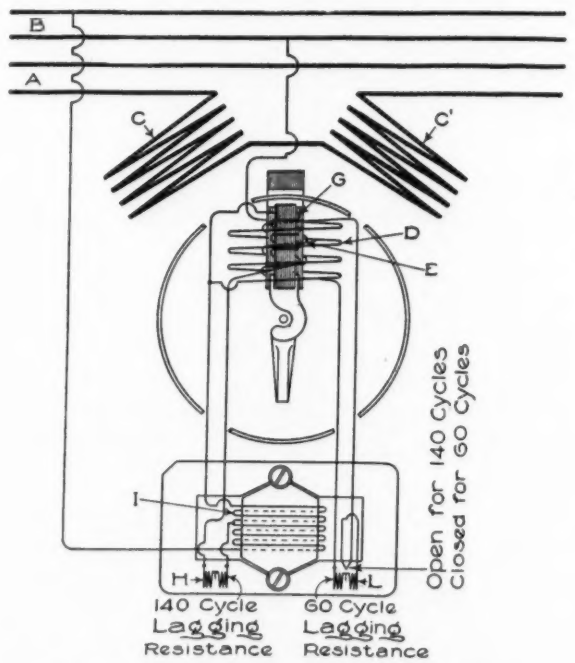


FIG. 2.—INTERNAL CONNECTIONS OF WATTMETER.

the phase position of the field established by the shunt coil which lags behind *O X* by the angle *S O X*.* The field, which is represented in position and magnitude by *O S*, passes through the rotating element, which, acting in the capacity of a closed secondary, has induced in it currents which produce a field, the phase position and magnitude of which are represented by *O M*. Then *O S* and *O M* in combination establish the resultant field, *O L*, which lags more than the desired 90° back of *O X*. Coil *G* (Fig. 2) is wound on the light-load adjusting arm, is electrically shunted across a

few turns of the impedance coil, *I*, and is located within the opening in the shunt coil, *D*. This coil produces the component field, *O K*, the magnitude of which is determined by the 140-cycle lagging resistance, *H*. With the magnitude of *O K* properly adjusted its combination with *O L* will establish a resultant field in the desired position 90° from *O X*.

When the meter is connected on a load having unity power factor, the 90° phase displacement between the fluxes due to the shunt and the series elements gives a torque proportional to the volt-amperes in the circuit, and for power factors less than unity the torque will vary directly with the cosine of the angle between the current in the series coil and the e.m.f. across the shunt coil, which condition must be obtained to measure accurately the true energy.

Thus far there has been considered the adjustment for only one frequency, while as a matter of fact, in practice, the meter is double-lagged and is practically acurate for quite a variation from the normal frequencies for which it is adjusted. When operating at 60 cycles the phase relations are as represented in Fig. 4. It will be observed that *O N* no longer maintains its 90° position with respect to *O X*, the reduced frequency having caused the following changes: Reduced the magnitude of the angle *S O X;* reduced the magnitude of the angle *K O X;* reduced the magnitude of the component *O K;* reduced the magnitude of the component *O M*. In order again to obtain the 90° displacement between the fields due to the series and shunt elements, the coil *E* (Fig. 2) is wound upon the core of and placed in inductive relation with the shunt coil, *D*, and the current in it is controlled by the 60-cycle "lagging resistance," *L*, in series with it. This coil establishes a component field, *O Q*, the magnitude of which is adjusted by the resistance, *L*, and which in combination with *O N* gives the resultant field *O P* displaced 90° from *O X*.

No matter how accurate a meter may be initially, unless it is so constructed that it will maintain its accuracy for a reasonable length of time it does not fulfill all the requirements. This brings forward the questions of drag magnet construction, torque, friction and weight of moving element. As to the drag magnet, it is evident that absolute permanence is essential; for without it we might liken a meter to a steam engine without a governor. Certain manufacturers have discovered a process whereby there can be produced a magnet that will retain its strength for an indefinite period, and the purchaser should always investigate thoroughly this most important part of meter construction. The torque, which is directly proportional to the load, does its work in opposing the forces established by the eddy currents which are generated in the moving element by the permanent magnets. In addition to this it does work in overcoming all the friction of the moving parts. Since friction varies directly as the pressure between surfaces, it follows that the rotating element should be as light as possible.

Unfortunately, the friction in a meter does not remain constant, but increases with age. By reducing the weight of the rotating element, the percentage of increase of friction within a specified time is diminished, but not entirely eliminated. It is essential that some means be provided for compensating for even this slight increase in friction. The design and arrangement of such a device should be such as to be effective only on light loads. (See Fig. 5.)

It would seem that the essential features for maintaining continued accuracy in service is not high torque alone, nor great ratio between torque and weight of moving element alone, but high torque in combination with light weight of moving element, and high ratio between torque and weight of the moving element.

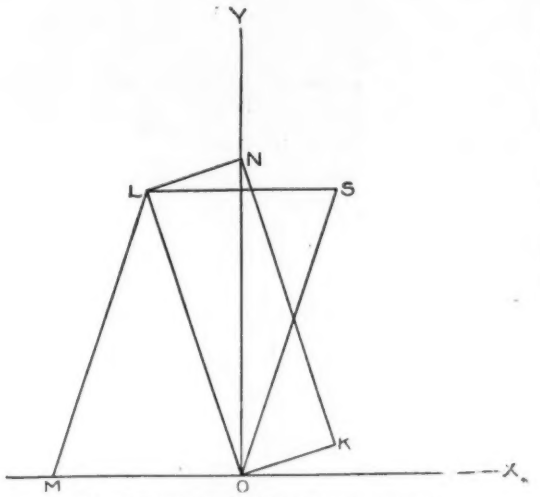


FIG. 3.—PHASE RELATION OF FLUXES.

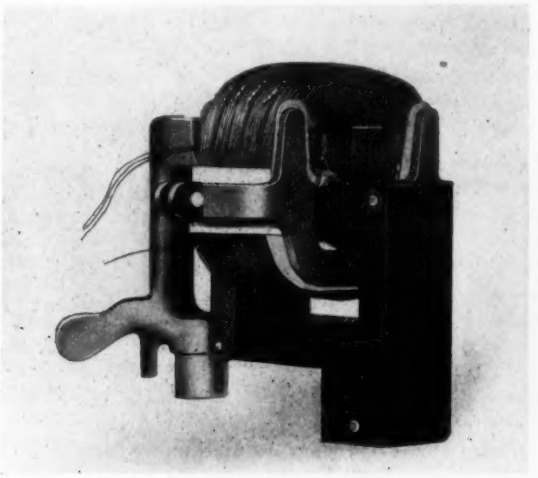


FIG. 5.—LIGHT LOAD ADJUSTMENT OF HIGH TORQUE WATTMETER.

FIG. 6.—WATTMETER WITH CAP AND DIAL REMOVED.

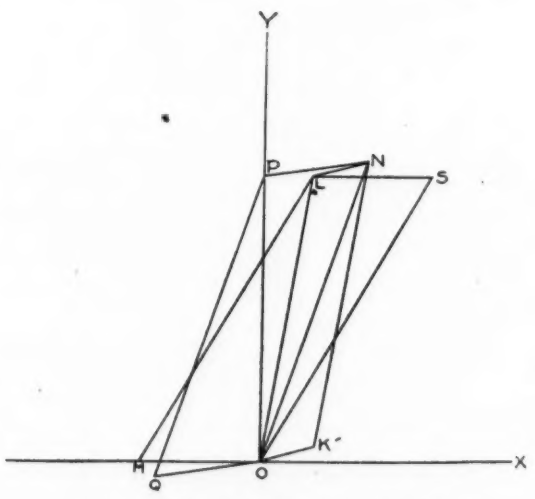


FIG. 4.—PHASE RELATION OF FLUXES.

FIG. 7.—INDUCTION WATTMETER, SHOWING TWO PERMANENT MAGNETS.

Westinghouse Bipolar Motors For Direct-Current Circuits.

A line of direct-current motors, to be known as the type R, has been produced by the Westinghouse Electric & Manufacturing Company to meet the demand for thoroughly reliable and highly efficient machines of small power which shall be easy to install, convenient to operate, require a minimum of attention and give continuous service throughout a long life. They are constructed in sizes from ⅛ to 1¾ hp and wound for 110 and 220 volts. The fields are shunt wound. Every detail has been designed and constructed with the same care that is given to larger apparatus. Many features of importance, often regarded as unnecessary for small machines and omitted in the effort to reduce cost, are included in this line of motors, known as type R. They will carry their rated full loads continuously without injurious heating, commutation is practically sparkless between no load and an overload of 50 per cent. or more, and within this range the brushes, once set, require no readjustment for change of load.

The yoke, brackets and poles are cast in one piece, a construction which gives a compact machine and provides a rigidity between the support and the driving pulley or pinion, seldom found in motors of the self-contained type. The bore of the bearing housing supports is the same as that of the field poles. Accordingly, the armature can be removed by simply taking out one bearing housing, and this may be done without removing the pinion or pulley, unless it is larger in diameter than the bore of the field poles. The front end bracket is formed by three arms, which afford protection to the commutator, but leave openings through which ready access to the brushes may be obtained. The two poles project inward in a horizontal plane and are magnetized by machine-formed coils. These coils are treated with both a weather-proof and an insulating compound, which insures them against ordinary dampness as well as accidental grounds or short-circuits. They are covered with a number of thicknesses of tape, to guard against mechanical injury.

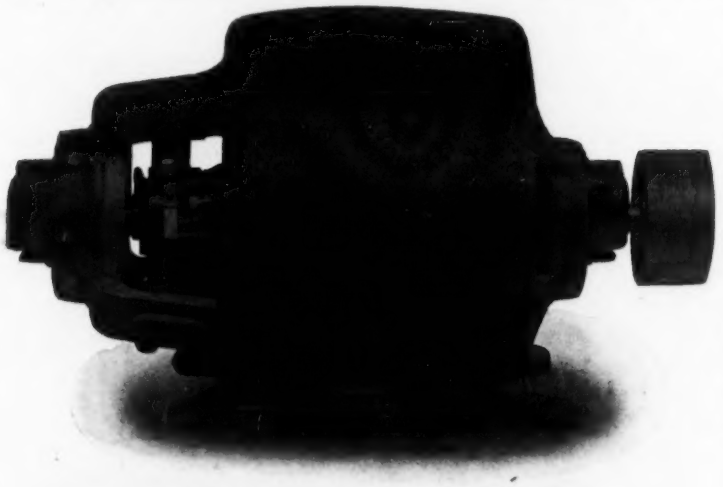


FIG. I.—DIRECT-CURRENT MOTOR.

The coil supports are small L-shaped pieces of sheet brass which are fastened to the poles by screws and which hold the coils firmly in place.

The bearings are of the ring self-oiling type, with linings of phosphor-bronze, mounted in separate housings which may be adjusted in any position, so that the oil reservoirs hang vertical whether the motor be set upon the floor or suspended from the wall or ceiling. The housings are so designed as to entirely prevent the leakage of oil, a defect often noticed in small motors running at high speed. Creeping of oil along the shaft is also prevented by the use of a properly designed oil thrower or wiper which protects the commutator and armature. The oil reservoirs are of ample capacity and the oil rings are easy to inspect, as they may be seen from the opening in the bearing housing.

The armatures are of the laminated slotted drum type with embedded coils which are retained in the slots by hard fibre wedges, without band wires of any kind. The armature laminations are of carefully annealed soft steel, treated to secure high magnetic quality and freedom from ageing. Steels not similarly treated rapidly deteriorate with age and may cause dangerous increase in temperature and some decrease in efficiency. The armature cores are mounted upon shafts of unusual strength, which are so designed that pulleys or pinions may be secured with keys—a construction far superior to that of a flat, which is often employed to hold the pulley of a small motor to its shaft. The leads to the commutator are adequately protected by a covering of treated cloth and tape and are thus tied down and so firmly held in place that there is practically no danger of a broken lead.

The brush holder arms are mounted upon rings which are supported at three points inside the motor frame. The individual

FIG. 2.—ARMATURE.

holders are of the sliding type with the rod construction and possess many features of especial merit. Pressure on the brush is exerted by a coiled spring in such a manner as to give the carbon a uniform pressure throughout its width. The carbons are held radial at all times, there being no swivel action during the operation of the machine. A quick action spring takes up any vibration that might otherwise occur and thus insures continual contact between brush and commutator and obviates jumping or chattering of the brushes. That the brushes fit the commutator is one of the requisites of good commutation. The holders support the brushes in a radial position even when the brushes have been well worn. There are two brushes on each motor, set diametrically opposite each other and easily reached through an opening in the front end bracket.

The commutators are made without necks—a construction which provides a maximum wearing surface and eliminates the possibility of the holders riding against the neck.

The terminals are of the brass bolt and nut construction and are located on the two lower arms of the front end brackets. The bolt or stud is threaded on both ends and is brought through insulated bushings and clamped into position by a nut on either side of the arm. These nuts are properly insulated by vulcabeston washers. Another nut on either end of the stud serves to fasten the leads. They are easily accessible and are largely protected from accidental short-circuit or other injury by their position.

The starting rheostats are of the most approved design, with automatic no-voltage release, exceedingly small and compact and of the best possible construction, fire-proof throughout. The resistance is of the bar wound type with porcelain insulation to ground, and is thoroughly ventilated. The adjustment is such that the motor starts without jar or abnormal rush of current.

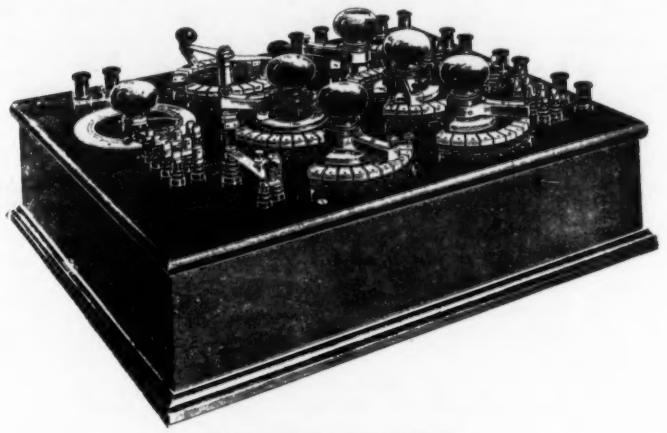
Motors of this type are applicable to practically every operation within the range of their capacity, where direct current is available, whether in the shop or in the home, in the store or in the office.

Queen Standard Potentiometer.

The Queen standard potentiometer, shown in the accompanying illustration, is contained in a case of highly polished mahogany. The top plate is of heavy rubber sheet, well polished and hand-engraved, with bold, distinct numbers and letters. All the parts and contact studs are mounted on corrugated rubber blocks, also highly polished, this construction rendering the insulating surfaces of extra length, easily cleaned and of most excellent appearance. Each of the studs, over which the sliding contact arm moves, is heavily faced on the upper surfaee, and a brush is mounted in the sliding arm, which makes contact with the surface of the stud and ring. The rubber handles are round and easily grasped, an improvement intended to relieve the operator from fatigue in working. The brushes are built up of thin laminæ of spring phosphor-bronze sheet, and are accurately ground into contact with the faced stud. Each of these brushes can be removed by slipping aside a steel spring which holds it in place; the switch arms are numbered and a corresponding number placed on the end of the brush next to it, so that they can be put back as easily as they are removed, and a contact as perfect as in the first instance is assured. The sliding surfaces are large and are ground

together to such perfect contact that any variation in this resistance may be absolutely disregarded. The moving switch contacts are accessible and readily removable. The resistance coils are wound on metal spools, which are more rigid, and permit a more even distribution of heat than the wooden spools ordinarily in use.

Three pairs of terminal binding posts are provided for various

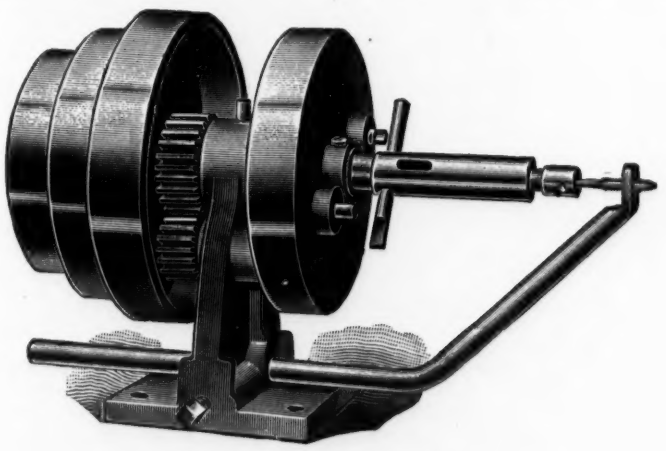


STANDARD POTENTIOMETER.

standard cells, one being for the Carhart-Clark cell, another for the cadmium cell and the third pair for any standard cell which may be used. In order that the resistance of each coil may be independently determined, a tapered hole is drilled in each stud, in which a traveling plug fits for connection to outside measuring instruments. The switches are so arranged that one or more standard cells can be connected to their respective terminal parts at the same time, but cannot possibly be interconnected, or more than one used at the same time. The double-pole, double-throw switch shows at once whether the standard cell or the unknown e.m.f. is connected in the circuit. By throwing this switch to the side marked "Standard," the strength of the current passing through the potentiometer can be checked; this can be done in the case of the Carhart-Clark or the cadmium cell, regardless of where the main switch stands.

Atlas Tapping Machine.

The accompanying illustration shows an improved form of tapping machine designed especially for rapid service. Its capacity is about 6,000 taps per day, being, in fact, limited only by the speed of the operator. In distinction to other machines of its kind, there is no friction whatever in the reversing of the spindle in the casing. The



TAPPING MACHINE.

spindle is arranged in the casing so as to stop after the reverse on each tap, leaving the spindle stationary, while the machine is running at full speed. This construction results in a saving of taps sufficient alone to pay for the machine. The tapper can be used for cutting threads on bolts by substituting a die for the chucks. The Atlas tapping machine is handled by William Albert Hall, 9 West Fourth Street, Cincinnati, Ohio, dealer in electric supplies.

Steam Turbine Plant in Klondike for Electric Dredges.

The Westinghouse Companies have just entered an order for the equipment of a power house for the electrical operation of gold dredging boats on the Alaskan rivers. The plan is an entirely new one and involves many interesting features.

A number of Detroit capitalists formed recently the Canadian Klondike Mining Company. A visit was made to the works of the Westinghouse interests at East Pittsburg to ascertain if electrical machinery could be used in the gold mining plant. After considering various plans, it was decided to install a 400-kw turbo-generator in the power house, to be driven by a 600-hp Westinghouse-Parsons steam turbine. The dredge boats are being built by the Marion Steam Shovel Company, of Marion, Ohio. On these boats will be installed induction motors, aggregating a total of about 500 hp, and varying in size from 7½ to 100 hp.

The power house will be located at Dawson City, and the dredges will operate on the Yukon River and its tributaries. Lines for transmitting power will be strung from the station to the boats, wherever they may be working. Electrical machinery is used very extensively in mining operations, but this plant will be watched with considerable interest, owing to the remoteness of the country and the new field which will be opened.

Conduit Bending Machine

The increasing use of metal conduits in electrical installations has developed a demand for some means for bending the tubes into the proper shapes required by the circuits. The accompanying illustration shows a bending machine which is especially applicable to this class of work. The machine is operated by a hand wheel carrying a pinion which engages with a quadrant gear and thereby causes the movement of the bending quadrant. The conduit or pipe

CONDUIT-BENDING MACHINE.

which is to be bent is held in position at one end by a U-shaped clip, while a pin or roller in the platen engages the other end. The curvature obtained is governed by the hole in which the pin or roller may be placed.

While being of a somewhat simple character, this machine will accomplish a marvelous complexity of work in the line of its intended duty. Piping of steel, iron, brass, copper or other material up to two inches in diameter can be bent while cold by one man. To bend a 2-in. pipe to an S form requires the work of one man for about three minutes. This machine has recently been designed and is now being placed upon the market by Pedrick & Smith, 222 East Girard Avenue, Philadelphia.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The cold, stormy weather had a depressing effect on trade, both wholesale and retail, and disorganized railroad transportation in some sections. It was of wide extent and interfered with various lines of industry, such as coal mining, coke and iron manufacturing. Prices of staple commodities at the exchanges are advanced by the restricted receipts at the principal markets. Relatively the Northwest and West suffered the most from the effects of the unfavorable weather, and the South and Southwest also suffered severely, while the East and Northeast felt the effects in only a slighter degree. Despite these temporary drawbacks, however, the situation is not without favorable features. The iron and steel situation is, if anything, rather stronger. Heavy sales of Southern pig iron are reported North and South, some large sales of rails are announced at the West, and the concern of consumers about supplies is reflected in advances for a number of lines of finished products. Collections are dull, in keeping with the quietness in trade. Money is easy, as heretofore, but a slight hardening is noted in call loans at New York. Railway earnings for January, though reflecting stormy weather and grain rate troubles, show a gain of 6 per cent., this, however, comparing with a decrease of 3.8 per cent. in the same month a year ago. Cotton has advanced slightly; May wheat in Chicago is apparently cornered with a consequent effect on prices; other cereals are higher on restricted movement and other staples and country produce are advanced in consequence of the weather conditions. The dry goods trade reports an increased demand for cotton goods for export to China and other countries. Copper is practically unchanged, the closing prices being 15.32¼c. for Lake, 15.20c. for electrolytic and 14.95c. for casting stock. *Bradstreet's* reports 243 business failures during the week ending February 16, against 207 the week previous and 231 the corresponding week last year.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, has recently secured a number of contracts for switchboard equipments designed to extend boards of other makes of apparatus. The International spring jacks are so constructed that they will receive the same size plug as used on the equipment to be extended, so that direct connection between the sections may be made. These extensions are being furnished in either the International self-restoring drop equipment or manual drop. Among recent orders for this class of extensions is a 100-line self-restoring drop board for extending a visual type board at Vinton, Iowa; a 100-line section for a second extension to a combination central energy and generator call equipment at Moberly, Mo., and a 100-line section to an old-style manual restoring drop equipment at Lexington, Mo. This type of equipment permits extensions without replacing or discarding the original installation.

EQUIPMENT FOR WILKESBARRE DISTRICT.—The West Side Electric Company, of Wilkesbarre, Pa., which controls the lighting franchises in Nanticoke, Plymouth, Edwardsville, Luzerne, Kingston, Dorrencton and Forty Fort—towns located in the vicinity of Wilkesbarre—all situated within a radius of seven miles, has awarded contracts for the equipment of its generating station at Kingston, which will have an initial capacity of 1,000 kw. The generators—two machines of 500 kw capacity each—have been ordered from the Allis-Chalmers Company. They will be of Bullock build and are to be arranged for direct connection to Nicholson Corliss engines to be turned out at the Vulcan Iron Works, Wilkesbarre. The West Side Company is controlled principally by Mr. Abraham Nesbitt, a big Wilkesbarre capitalist, and Mr. Ambrose West, of Plymouth.

ROOFING FOR MEXICAN POWER PLANTS.—The Brown Hoisting Machinery Company, of Cleveland, Ohio—New York offices, Mr. W. A. Stadelman, manager—secured recently a large contract for roofing material for the huge Necaxa power plant, and the sub-stations at Mexico City, and El Oro, of the Mexican Light & Power Company, Limited, of which Mr. Plummer, of 29 Broadway, New York City, is the purchasing agent. The Brown Company secured its contract through the Riter-Conley Manufacturing Company, of Pittsburg, Pa., which holds the complete contract for the construction of the Mexican Company's power plants and sub-stations. The roofing material to be used will be of reinforced concrete construction called "ferro-inclave."

THE BARNEY & SMITH CAR WORKS, of Dayton, Ohio, has begun the purchase of the materials necessary to the doubling of the capacity of the present plant. The first contracts for machinery were placed February 11 and included the new engines and electric generators for the extension of the main power plant. The Buckeye Engine Company was awarded the contract for two 400-hp engines, and the Crocker-Wheeler Company received an order through its Cincinnati office for two 275-kw electric generators. The generators and engines are to be of the direct-coupled, slow-speed type.

TO BUILD SECOR ENGINES.—The Marine Engine & Machine Company, 126 Liberty Street, of which Mr. Edward E. Pollock is the sales manager, has acquired the exclusive manufacturing and selling rights of the Secor stationary engine, which operates by gas, kerosene or alcohol. Among the contracts already secured are a number calling for engines to be direct connected to generators for lighting service. Mr. Eastman, of Kodak fame, has ordered two Secor engines of direct-connected type for lighting his private residence at Rochester N. Y.

RESULT OF TELEPHONE GROWTH.—The New York Telephone Company issues this statement: "The present rapid increase in the number of telephone lines in this city necessitates a corresponding increase in the number of central offices. This is accomplished by subdividing existing central office districts, making it necessary to change the telephone numbers of the lines in the new districts. For this reason it is not possible for us to guarantee the permanency of any telephone call number, and we do not advise subscribers to have same printed on their stationery."

PLANT FOR COLLEGE BUILDINGS.—The equipment to be installed in the power plant, which is to light the group of college buildings being constructed at 138-140th Streets, St. Nicholas Terrace to Amsterdam Avenue, will include four 250-kw generators arranged for direct connection to 350-hp, compound Corliss condensing engines and one generator of 150 kw capacity, to be direct-connected to a 225-hp engine. Pattison Brothers, Flatiron Building, are the electrical engineers.

EXPORTS AND IMPORTS.—Merchandise exports from the United States for January, 1905, were $123,450,404, and the imports, $98,358,756, leaving an excess of exports of $25,091,648. For the seven months ending January, the exports of merchandise were $901,038,047, and the imports, $625,930,793, leaving an excess of exports of $275,107,254. The excess for the seven months in 1903 was $363,399,262.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY reports that it is just completing one of the finest toll boards for the United States Telephone Company, at Toledo, Ohio, that it has ever turned out. The board consists of five sections of three operators' positions each. The board is equipped throughout with the most modern apparatus.

CONTRACT FOR FLEMING ENGINES.—A contract awarded the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., by the Detroit, Flint & Saginaw Railway Company provides for the installation of two tandem compound Fleming engines, each direct-connected to a 250-kw generator. These engines will be built for particularly severe service.

APPARATUS FOR ST. LOUIS.—A contract for electrical machinery, aggregating $175,000, has been awarded to the National Electric Company, Milwaukee, by the Union Electric Light & Power Company, of St. Louis, which was recently absorbed by the North American Company. The machinery is to be used in the company's substations.

ANOTHER DE LAVAL TURBINE FOR MEXICO.—The United States Mining Company, which operates mines in the Parral district, State of Durango, Mexico, has placed a contract, through the H. D. Crippen Manufacturing Company, of 25 Broad Street, for a 300-kw. De Laval turbine to be installed in its power plant.

TWENTY-FIVE THOUSAND-HP CALIFORNIA PROJECT.—The engineering and contracting firm of Sanderson & Porter, Kuhn-Loeb Building, is preparing plans for the construction of a big water-power plant in California, which will have an initial capacity of some 25,000 hp.

EQUIPMENT FOR JAPANESE PLANT.—The Himeji Electric Light Company, of Japan, has placed a contract with the Buffalo Forge Company, 39-41 Cortlandt Street, for the shipment of a large tandem compound engine to be installed in its plant.

EXPORTS TO CUBA.—The United States Bureau of Statistics reports that specific electrical exports to Cuba in 1904 were $35,195, as compared with $28,016 in 1903.

Financial Intelligence.

THE WEEK IN WALL STREET.—Bullish manipulation on the stock market was in evidence, this being rendered possible by the continued ease in money, sustained demand for investments and absence of selling of securities. The coal stocks and other standard stocks were the features and most traded in, new record prices resulting in some cases, though public participation in the market is still limited. Bonds continue firm and the demand is good. Renewed importance was given to the effect of the steel trade improvement upon the earnings of the United States Steel Corporation, particular stress being laid upon intimations that the earnings for January will aggregate $9,000,000 and foreshadow a very successful quarter for the concern. The common stock took the lead and was once more the object of aggressive manipulative support. Electric and traction securities did not exhibit any marked movements. The tractions were weaker and the trading in them was rather slack; in the other class business was narrow, but prices were well maintained. Allis-Chalmers common closed at 18, a net gain of 1½ points, and preferred at 67, an increase of 2 points. General Electric touched 188¾, but fell off and closed at 186¾, this being a net loss of ¼ point. Two hundred shares of Westinghouse common were sold at 178, which was the only quotation of the week, and representing a net loss of 1¾ points. Western Union Telegraph is ⅛ point higher, closing at 93⅜, and American Telephone & Telegraph 1⅛ higher, the closing quotation being 114⅞. Brooklyn Rapid Transit lost ⅛ point, closing at 62¼, and Metropolitan Street Railway closed at 121⅜, a loss of ⅞. Interborough Rapid Transit closed at 215. On the curb market this stock declined because of liquidation sales. Following are the closing quotations of February 20:

NEW YORK

	Feb. 14	Feb. 20		Feb. 14	Feb. 20
Allis-Chalmers Co.	16⅝	17¾	Electric Vehicle	15	14
Allis-Chalmers Co. pfd.	62	65¼	Electric Vehicle pfd.	23¼	22
American Tel. & Cable.	94	94	General Electric.	186½	186
American Tel. & Tel.	141	144⅛	Hudson River Tel.	..	..
American Dist. Tel.	30	32	Interborough Rap. Tran.	218	209
Brooklyn Rapid Transit.	62¼	62⅜	Metropolitan St. Ry.	122⅛	120⅜
Commercial Cable.	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	39	39½	Marconi Tel.	..	..
Electric Boat pfd.	79	79	Western Union Tel.	92¾	93⅜
Electric Lead Reduction	¼	¼	Westinghouse com.	178½	178
			Westinghouse pfd	185	190

BOSTON

	Feb. 14	Feb. 20		Feb. 14	Feb. 20
American Tel. & Tel.	142⅛	145	Western Tel. & Tel. pfd.	102	102
Cumberland Telephone	120	121	Mexican Telephone	1	1⅛
Edison Elec. Illum.	250	251	New England Telephone	136	*134½
General Electric.	185½	186	Mass. Elec. Ry.	13¾	13¾
Western Tel. & Tel.	20½	20¾	Mass. Elec Ry. pfd.	55	57

PHILADELPHIA

	Feb. 14	Feb. 20		Feb. 14	Feb. 20
American Railways.	50	50½	Phila. Traction.	100⅝	101
Elec. Storage Battery.	78	84½	Phila. Electric.	10¼	10⅝
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	28½	30
Elec. Co. of America.	10½	12¼			

CHICAGO

	Feb. 14	Feb. 20		Feb. 14	Feb. 20
Central Union Tel.	..	..	National Carbon pfd.	111	113
Chicago Edison.	157½	172	Metropolitan Elev. com.	20½	20
Chicago City Ry.	..	..	Union Traction.	11⅛	..
Chicago Tel. Co.	141	..	Union Traction pfd.	48½	..
National Carbon.	42¼	43			

*Asked.

NEW YORK CENTRAL TROLLEYS.—Through its acquisition jointly with Delaware & Hudson of the Schenectady Railway Company the New York Central, says the *Wall Street Journal*, now holds firmly control of the trolley situation up the State. With its present holdings as a nucleus it can round out its trolley system and develop its plans for subsidiary electric lines in its New York State territory in accordance with the views of the now aggressive management. Not until the joint purchase of the Schenectady Company could the Central be said to have worked out of the danger zone and avoided what at one time seriously threatened both its freight and passenger business. It is not now practicable for independent and competing electric lines to parallel New York Central tracks. But the danger was narrowly avoided. When the New York Central management two years ago awoke to the threatened existence of parallel and competing trolley lines in up-State territory, it required some time to formulate plans to avert it. These have now so nearly been put into execution that the danger is removed. The price paid by the New York Central and the Delaware & Hudson for the Schenectady Railway Company is reliably given as follows: First, $2,000,000 cash for the entire issue of stock of the company, $7,000,000 authorized and $600,000 outstanding. Second assumption of the entire bonded indebtedness of the company, including $2,000,000 first mortgage 4½ per cent. gold bonds due in 1941 and $750,000 consolidated mortgage 4½ per cent. bonds, due 1953. The Schenectady Railway Company operated the entire system of street railway, electric light and power systems of Schenectady and suburbs with extensions to Albany and Troy and a line to Ballston, a total mileage of 102. In the fiscal year 1903 the total earnings of the system were $1,007,513 and the net $348,646. It serves a population of about 300,000 and is capable of important extensions.

ELECTRICAL SECURITIES BONDS.—The Electrical Securities Company, controlled by the General Electric, now has outstanding $2,000,000 of its 5 per cent. collateral trust sinking fund bonds. The second series of $1,000,000 is dated February 1, 1905, due February 1, 1935. The first series is due November 1, 1934. The collateral under the second series is as follows: Anniston Electric & Gas 5s, $50,000; Asheville Electric 5s, 1941, $100,000; Chattanooga Electric 1st consol. 5s, $50,000; Oklahoma Gas & Electric gen. 5s, $125,000; Ft. Smith Light & Traction 5s, $50,000; Omaha Electric Light & Power 1st 5s, $175,000; Union Electric of Dubuque 1st 5s, $50,000; Montana Power Trans. 1st 5s, $240,000; Northern Ohio Traction & Light consol. 4s, $145,000; Northern Ohio Traction Light consol. 5s, $60,000; Columbus, Newark & Zanesville Elec. Ry 1st 5s, $100,000; Indianapolis & N. W. Traction 1st 5s, $125,000; total, $1,270,000. The corporation has the right to redeem all or any part of the collateral trust bonds on any interest day upon twenty-one days' notice, and beginning with February 1, 1910, is required to gradually retire said bonds, either by purchase or redemption. Upon the retirement of collateral trust bonds or the deposit of money with the trustee for the purpose of retirement, the corporation is permitted to withdraw collateral securities to an amount of principal not exceeding one hundred and sixteen per centum of the collateral trust bonds, so retired or for whose retirement funds have been so provided. As the amount of collateral security is originally one hundred and twenty-five per centum of the collateral trust bonds, it will be seen that as the collateral trust bonds are retired, the collateral security for the bonds remaining is proportionately increased.

TELEPHONES FOR BROKERS.—The financial page of the *New York Times* has the following: "The far-reaching storm in the South and West caused considerable inconvenience to the wire houses last week. Communication with Chicago was fairly well maintained, but to Palm Beach, New Orleans, Memphis, and other Southern resorts wires were practically out of commission. Long-distance telephone wires were in better shape, thus repeating the experience of other recent storms when the telephone could be used while the telegraph was out of commission. This accounts for the increase in the number of private long-distance telephone wires leased by big Wall Street firms. It is estimated that there are in use at least thirty private long-distance wires, for which the firms pay an annual rental of $10,000 each. Some of the big market operators nowadays try to avoid getting too far away from the telephone, and private long-distance telephones are therefore said to pay the brokers very well indeed."

GENERAL ELECTRIC ACTIVITY.—Stock markets reports show the General Electric Company to be doing well. The General Electric Company issued a statement last June at the time it brought out its new issue of stock, showing the operations for the first four months of the fiscal year, which began on February 1, 1904. Although its business during that period suffered from the low ebb of the trade reaction, it paid its regular dividend and added $1,577,096 to the reserve fund. This fund, after having been reduced to small proportions in 1902, when a scrip dividend of 66 2/3 per cent. was paid, had on May 31 grown again to $8,870,784. It is estimated in well-informed quarters that by January 31, the close of the fiscal year, the reserve fund probably will be shown to have increased to between $11,000,000 and $12,000,000.

DIRECT UNITED STATES CABLE.—Reflecting the business depression of part of 1904, the Direct United States Cable Company has paid a dividend for the year of only 3 per cent., the lowest since 2½ per cent. paid in 1896. The company, which has an issued capital of £1,214,200, works 4,000 miles of cable connecting London and Liverpool with New York and Canada. The figures of recent years are subjoined:

	Gross.	Net.	Dividend, per cent.
1904	£94,151	£53,106	3
1903	96,702	55,352	3¼
1902	99,154	59,007	3¼
1901	100,239	60,594	3¼
1900	102,738	64,018	3½

TELEPHONE MORTGAGE.—The Kansas City Long Distance Telephone Company has filed mortgages for $1,500,000 in Kansas City, Kan., and in Nevada, Mo., in favor of the Commonwealth Trust Company, of St. Louis, Mo. The Kansas City Long Distance Telephone Company is the long distance auxiliary of the Kansas City Home Telephone Company, and was formerly known as the Western Independent Telephone Company.

CINCINNATI BELL TELEPHONE.—Cincinnati dispatches state that the City & Suburban Bell Telephone Company has voted to increase its capital stock from $4,000,000 to $5,000,000 to take in suburban lines. The acquisition of some "independent" properties is rumored.

General News of the Week

The Telephone.

SANTA CLARA, CAL.—The Santa Clara Valley Home Telephone Company has been incorporated. Directors: Charles F. Guthridge, Charles L. Zahn, D. F. Boyce, C. P. Platt and Arthur Wright, of Los Angeles. Capital stock, $75,000; paid in, $10,000.

SANTA MONICA, CAL.—The stockholders of the Home Telephone Company have authorized an issue of $150,000 worth of bonds at 5 per cent. The money will be used to complete the system being constructed here to include Santa Monica and Ocean Park.

NEW HAVEN, CONN.—The annual stockholders' meeting of the Southern New England Telephone Company has been held. President Tyler reports a most prosperous year which has been the record year in the company's history and closes with 33,208 stations, a net gain for 1904 of 6589. New central offices were opened during the year at Cheshire, Fairfield, Glastonbury, and other places.

CORNELL, ILL.—The Cornell Telephone Company has been organized by H. W. Smith, Jones Blue and E. A. Partridge.

PAWNEE, ILL.—The Sangamon County Telephone Company has been incorporated with a capital stock of $20,000, by H. E. Farham, E. K. Farham and others.

CHICAGO, ILL.—The Guarantee Telephone & Equipment Company has been incorporated with a capital of $2500. The incorporators are L. Anderson and Albert Duce.

BRADFORD, ILL.—The Osceola-Neponset Telephone has closed out and transferred its business to the Buda-Bradford-Milo Telephone Company with headquarters in Bradford. The following are the officers: Cyrus Bocock, president; Geo. A. Carper, vice-president; John McLane, treasurer; John H. Drawyer, secretary and treasurer.

McLEANSBORO, ILL.—The Marion County Co-operative Telephone Company has elected these officers: Jacob Hershberger, president; H. R. Stevenson, vice-president; George White, secretary; John S. Stonecipher, treasurer; Jacob Hershberger, Dr. T. J. Green and John Daniels, directors. The company is now engaged in building its lines to Salem and will establish a central office.

BLOOMFIELD, IND.—The New Home Telephone Company contemplates extensive improvements in the city and the large country territory which it serves.

FT. WAYNE, IND.—The Hoagland & Marion Township Telephone Company has elected C. F. Hubler, president; Charles Swick, secretary, and E. F. Koeneman, treasurer.

INDIANAPOLIS, IND.—Articles of incorporation have been filed with the Secretary of State for the Sparta & Hogan Telephone Company of Dearborn County. Capital, $700.

ALAMO, IND.—The directors of the Alamo Telephone Company have purchased a building and will remove the switchboard and offices thereto. The system will be extended and other improvements made.

RUSHVILLE, IND.—The City Council has refused a franchise to the Spiceland Co-operative Telephone Company, under the supposition that the Bell Telephone Company was behind the application.

TIPTON, IND.—The Fairview Co-operative Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $1025. W. H. Achenbuck, S. J. Bozell and Chas. Mclury are the incorporators.

WABASH, IND.—The Bell Telephone Company has completed the work of equipping the Ft. Wayne & Wabash Valley Traction lines between Ft. Wayne and Logansport with a telephone system both for dispatching trains and for general business.

BATTLE GROUND, IND.—The Battle Ground Telephone Company has incorporated to build and operate telephone lines and exchanges in Tippecanoe, Benton and White counties. The capital stock is $1500. W. J. Walters is president and Edward Towers, secretary.

BUNKER HILL, IND.—Because of dissatisfaction with the service and rates the Bell Telephone Company, operating here, was petitioned for a monthly rental at $1, and better service. The company making no reply, the Town Council granted a franchise to a company of citizens to construct an independent telephone plant in the town.

ATLANTA, IND.—A new telephone company has been organized in the territory northeast of Atlanta, with 41 stockholders. The central station will be connected with the Tipton system. The rental will be $12 per year with access to the Tipton lines. Officers for the company have been elected as follows: W. H. Achebach, president; D. C. Hobbs, Jr., secretary; Clarence Conway, treasurer.

MANSON, IA.—The Central Mutual Telephone Company expects to spend about $4000 in Manson during the present spring for the extension, improvement and rebuilding of its lines.

DAYTON, IA.—The capital stock of the Dayton Telephone Company has been raised from $10,000 to $25,000 and arrangements made for the general expansion of the business of the concern.

TOPEKA, KAN.—The Woodston Mutual Telephone Company has been incorporated, capital $4000.

TOPEKA, KAN.—The Macksville, Prattsburg and Nora Telephone Company, capital $1000, has been organized.

MULVANE, KAN.—The Mulvane Mutual Telephone Company has been incorporated with a capital stock of $2000.

NEVADA, LA.—The Nevada Mutual Telephone Company will erect a new exchange in this city at a cost of $3000.

SAGINAW, MICH.—The Saginaw Valley Telephone Company, which was recently organized with a capital stock of $850,000, will take over and extend the property of the Valley Telephone Company.

CLIO, MICH.—The Michigan State Telephone Company will consolidate its Clio and Mt. Morris exchanges. This consolidation, with the extension of farm lines out of Clio and Mt. Morris, will give subscribers free service with Clio, Mt. Morris County Line, Arbela, Farrandville and Pine Run.

LESLIE, MINN.—The Leslie Rural Telephone Company proposes to increase its capital to $10,000 for the purpose of extending its lines.

ROYALTON, MINN.—A number of farmers living in the vicinity of Rice and Royalton are discussing a telephone line to connect these towns with Foley.

LITTLE FALLS, MINN.—The Morrison County Telephone Company has decided to construct a telephone line from Little Falls to Staples early in the spring.

WINNEBAGO CITY, MINN.—The Southern Minnesota Telephone & Telegraph Company has been formed with $100,000 capital. W. A. Streeter is secretary.

BELGRADE, MINN.—The articles of incorporation of the Commercial Telephone Company, of Belgrade, Minn., have been filed. The capital stock is fixed at $50,000 and the indebtedness is limited to $25,000. The officers are T. J. Anderson, president; C. Borgerding, vice-president; J. F. Chisholm, secretary, and A. Ridgeway, treasurer.

JACKSON, MISS.—The Cumberland Telephone & Telegraph Company is buying up a number of local telephone lines in towns along the Gulf and Ship Island Railroad. It is the purpose of the Cumberland Company to put through a long-distance line from Jackson to Hattiesburg and intermediate points along the Gulf and Ship Island Railroad, and it is necessary to secure the local lines before the long-distance line is constructed. The latest important negotiation in which the Cumberland Company is involved is the purchase of the Citizens' Long Distance Telephone Company, which has quite a number of lines in the eastern part of Mississippi and western part of Alabama. The deal will be closed within a few days. During the past two years the Cumberland has spent over $1,000,000 acquiring new lines and making improvements on its system in Mississippi.

HANNIBAL, MO.—The Pike County Telephone Company has been incorporated; capital $2500.

GHENT, MO.—The Caddo Cove Telephone Company, of Ghent, capital $20,000, has been formed. The incorporators are J. Johnson, T. J. Hughes and others.

WILSONVILLE, NEB.—The Inter-State Telephone Company, with a capital stock of $10,000, has been incorporated by A. W. Hunt, E. W. Parker and others.

OMAHA, NEB.—West of the Mississippi River the Bell Company is pushing a line rapidly from Omaha, Neb., to Denver, Col. It is the intention to extend this line on to the coast, and if possible to complete it this year. The local lines in the West are also being increased and facilities multiplied.

MINDEN, NEB.—At a meeting of the City Council a franchise was granted to an independent telephone company to build and operate a system in Minden and Kearney County. Before granting this franchise an ordinance was passed revoking the franchise granted to the Kearney Construction Company. The franchise was granted several months ago and under its terms the company was to begin work within a specified time. As it failed to do this, its franchise was revoked.

OGALLALA, NEB.—Articles of incorporation have been filed with the Secretary of State by the Ogallala and Big Springs Telephone Company, with a capital stock of $55,000. The incorporators are James Gray, E. D. Harrison and W. J. Harris. The South Fork Independent Telephone Company of Amelia, Holt County, with a capital stock of $2000 has also been incorporated.

OAK CORNERS, N. Y.—The residents of this city, which is in Ontario County, have organized the Home Telephone Company with a capital of $25,000.

VOLNEY CENTER, N. Y.—The Volney Telephone Company has been organized with officers as follows: President, Robert Simpson, Jr.; vice-president, C. E. Sackett; secretary, Eugene Rowe; treasurer, E. E. Hart. The central station of the new company will be located at Volney Center, and the system will furnish service to the farmers along the route, working in connection with the Ontario Company.

BINGHAMTON, N. Y.—Papers of incorporation of the Nanticoke Valley Telephone & Telegraph Company have been filed. The towns connected by the new line will be Maine, Union Center, Union, Vestal, Willow Point, Endicott, Hooper, Lestershire and Binghamton. The capital stock is $1000. The directors are William Bronk, of Maine, N. Y.; Eugene M. Andrews, Clarence Stephens, Wayne Woodward, Frank Robbins, Union Center, and Lynn W. Pitkin and F. P. Neff, of Union.

WILMINGTON, N. C.—Wilmington and Southport, N. C., will be connected by long distance telephone, Capt. J. T. Harper being interested.

GREENSBORO, N. C.—The Southern Bell Telephone Company has begun the work of putting its wires underground in the business section, in compliance with an ordinance of the Board of Aldermen. The work is to be completed within 12 months.

WINSTON, N. C.—The city of Winston has rescinded its action of Jan. 21, when a conditional franchise for a telephone system was granted to F. W. Siebert. Permission was given, however, to put in a long distance line. It is possible that the town will, itself, or through the Board of Trade and Merchants' Association, establish a new system.

FARGO, N. D.—The Tri-State Company's line between Grand Forks and Minneapolis is in operation. The gap in Fargo and Moorhead where the telephone company was denied permission to construct poles is bridged by using the wires of the Western Union Telegraph Company.

WABASH, OHIO.—The Home Telephone Company has increased its capital stock from $20,000 to $50,000. R. G. Blount is president.

HAMILTON, OHIO.—The Home Telephone Company, of this city, has made an offer for the purchase of the Bell Telephone Company's interests in Hamilton.

NASHVILLE, OHIO.—The Central Union Telephone Company has purchased all of the property in Washington County of the Southern Union Telephone Company.

CLEVELAND, OHIO.—At the annual meeting of the Cuyahoga Telephone Company a new board of directors was elected, and the directors in turn re-elected the present board of officers. According to the report of President Dickson in March, 1904, the company had 10,260 telephones, while January, 1905, it had 14,370, a gain of 4110 telephones, of which 659 were secured during December. The company plans to expend during the year about $841,000 in developing its plant and supplying the additional requirements. This plan includes 6000 additional telephones. The company has acquired the Collinwood plant at an expense of $32,000. Its power to issue bonds is being gradually increased as its list of subscribers grows. During the past year the company earned all its charges, dividends on its preferred stock and a surplus of $10,891.06.

APACHE, OKLA.—The American Rural Telephone Company has been formed, capital $10,000. Incorporators: J. H. Mallory, L. Beckman and R. N. Mallory.

WILKESBARRE, PA.—The stockholders of the Consolidated Telephone Company have authorized a bond issue of $500,000, the intention being to apply the money on improvements.

BAIRD, TEX.—The Home Telephone & Electric Company of Baird, Callahan County, has been formed with a capital of $25,000, incorporated by I. N. Jackson, S. L. Driskill, T. S. Powell, S. H. Ramsey, Bertie Richardson, all of Baird, and J. M. Estes, of Clyde, Tex.

BINGHAM, UTAH.—An exchange has been established here by the Utah Independent Telephone Company.

PROVO, UTAH.—The Utah Independent Telephone Company has a petition before the City Council asking for a franchise.

PARK CITY, UTAH.—The Rocky Mountain Bell Telephone Company is opposing the application of the Utah Independent Telephone Company for a franchise to operate its system in this city.

SPOKANE, WASH.—As a result of its expressed decision to employ only union workmen, the Independent Telephone Company is meeting with opposition from the American League of Independent Workmen in its effort to secure a franchise.

SUPERIOR, WIS.—At a meeting of the Common Council, the People's Telephone Company was given permission to issue additional bonds to the extent of $70,000.

LAFAYETTE, WIS.—The Wilcox Valley Telephone Company, of Lafayette, has been formed, capital $2500. The incorporators are Albert E. Harris, Charles J. Fox and Thomas Grady.

RUSSEL, WIS.—At a meeting of the farmers near Russel a farmers' telephone company was formed. The following were elected officers: President, Mike Roskos; secretary, A. Melsness; treasurer, Halvor Veum.

OXFORD, WIS.—The Oxford & New Haven Independent Telephone Company has been formed to operate in Marquette and Adams counties; capital stock $1350. Incorporated by J. J. Scholikoph and O. W. Chafin.

EDGERTON, WIS.—By a deal made recently the Edgerton Telephone Company secures the business of the Bell long distance line into this city. The wires of the latter company will be connected with the local company's switchboard, and the Bell office discontinued.

FERNIE, B. C.—Mass meetings have been held here, at which opposition has been strongly expressed to the proposed establishment of an exchange by the British Columbia Telephone Company. The citizens advocate municipal ownership of telephones.

PETERBORO, ONT.—The American Machine Telephone Company, which is reported to have sold its rights to the Lorimer Company, of Chicago, is installing a telephone system in the city of Peterboro, Ont., in opposition to the Bell Telephone Company. Mr. Neil, the president of the American Machine Company, expects to obtain a similar franchise in the city of Brantford, Ont.

OTTAWA, ONT.—It is expected that the telephone question will again come up before the City Council at an early date. Last year the Canadian Telephone & Telegraph Company made a determined fight to get a franchise to do business in Ottawa. The company, composed chiefly of United States capitalists, made a strenuous argument, but the City Council could not see it their way, and an exclusive franchise for two years was given the Bell Telephone Company. The agreement does not expire till July 4, 1906, but the promoters of the new company are taking time by the forelock, Three representatives of the company are now in the city, endeavoring to get a franchise so as to be in a position to do business so soon as the agreement with the Bell Company expires.

Electric Light and Power.

SYLACAUGA, ALA.—The sale of $24,000 bonds of the town of Sylacauga has been confirmed, the purchaser of the bonds being P. L. McEldry, of Talladega, Ala. The proceeds are to be used in constructing an electric light and water plant for the town. Contracts will be let at once.

POCAHONTAS, ARK.—S. C. Dowell, of Walnut Ridge, is reported interested in the construction of a $25,000 electric light plant at Pocahontas.

GREELEY, COL.—The Greeley Gas & Electric Company has been incorporated with a capital of $50,000 by Chas. E. Ramsay, Martin A. Bunker, Burton D. Sanborn and others.

SEYMOUR, CONN.—The Seymour Electric Light Company has applied to the Legislature for permission to increase its capital stock to $100,000 and to issue bonds.

WASHINGTON, D. C.—Bids will be received March 7 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Washington, D. C., and Norfolk, Va., a quantity of arc lamps, incandescent lamps, induction coil, wattmeters, wire, conduit and fittings, electrical supplies, Goubert feed-water heater, injector, condenser, motors, wire rope, etc. H. T. B. Marris, Paymaster General, U. S. N.

CARTERSVILLE, GA.—The City Council has appointed a committee with W. H. Milner, as chairman, to investigate the question of constructing an electric light plant and a sewerage system.

ALBANY, GA.—The Albany Power & Mfg. Company has awarded to B. H. Hardaway, of Columbus, the contract for constructing a dam and power house at Big Shoals on Kinchafoonee Creek. The contract price is reported to be about $100,000.

SAVANNAH, GA.—The Savannah Lighting Company has filed a petition for incorporation; capital $50,000. The plant will be located on the grounds of the Savannah Lumber Company. Incorporators: John J. Cummings, Lawrence McNeil, J. H. Estill, and others.

ELGIN, ILL.—The Elgin Hydraulic Company is interested in the construction of a power plant at Elgin.

SOUTH ELGIN, ILL.—V. W. Panton, owner of the electric light plant, has in contemplation some extensions.

AURORA, ILL.—The Aurora Manufacturing & Lighting Company has been organized for the purpose of carrying on a general manufacturing business and for furnishing light, heat and power. The incorporators are Percy G. Lincoln, F. W. Detray and T. J. Helphrey.

JERSEYVILLE, ILL.—The Jerseyville Illuminating Company, recently incorporated with a capital of $1000, has increased its capital stock to $105,000. All the stocks and outstanding bonds of the Jerseyville Heat, Light & Power Company have been absorbed by the Jerseyville Illuminating Company.

EAST ST. LOUIS, ILL.—Announcement is made of the incorporation of two new companies, capitalized at $75,000 each, to furnish electric light and power to citizens of East St. Louis in opposition to the Citizens' Electric Light & Power Company. Both have applied for State charters and are at work on petitions to present to the City Council in an application for a franchise. The names of the companies are: St. Clair Light & Power Company organized by C. L. Gray, Harry C. Bernard and Robert Sikking, and the East St. Louis Consumers Electric Light & Power Company, the promoters being H. J. DeHaan, Fred Ziegenhein, Charles O. Mauer, Herman O. Thoene, C. O. Clark, Russell A. Richardson and S. P. Chapin. In addition to these companies, the Illinois Illuminating Company franchise, which is promoted by Mr. Bruckman, of St. Louis, will probably come up for final consideration at the Council meeting.

HOPE, IND.—George S. Cook has secured a franchise to establish an electric light plant in this town.

NEW ALBANY, IND.—The Mayor and Board of Aldermen on Feb. 8 ratified and declared valid the election for the issue of $20,000 bonds for water works and an electric light plant.

TERRE HAUTE, IND.—The City Council has passed an ordinance, appropriating $1200 with which to employ an engineer to prepare plans and specifications for a municipal lighting plant.

BICKNELL, IND.—Mr. F. P. Emison, superintendent of the Lynn coal mine, has organized the Bicknell Light & Power Company and has secured a franchise to light the town with electricity. The company will furnish heat and power also.

NOBLESVILLE, IND.—The City Council has awarded a ten-year contract to light the city to the G. W. Heinzmann Company, at $70 a light per year for arcs, and 10 cents per kilowatt-hour for incandescents. The old electric light company which now has the contract, and the Noblesville Hydraulic Company are consolidated with the new company. The large dam across White River will now be completed and the power made available. The old plant will be remodeled and held in reserve and the two will represent an investment of $150,000.

WARSAW, IND.—The Winona Assembly Company has purchased the Warsaw Water & Light Company's plant and fifty years franchise to light the city. The system will be thoroughly overhauled and considerable new equipment installed. It is the purpose of the company to expend about $600,000 on the new power plant and build it sufficiently large to supply all power needed for the various enterprises under its control, including not only the new water and light holdings, and the Winona-Warsaw electric railway, but also the Warsaw-Goshen line, and the proposed Warsaw-Wabash and Peru lines, which are to be built this year.

RED OAK, IA.—The Red Oak Electric Company proposes installing two 150-hp boilers and one 600-hp horizontal engine, direct connected to a 500-kw generator. D. F. McGee is manager.

CLARINDA, IA.—The Lee Electric Light Company is a new corporation organized to take over the copartnership of the Lee Electric Light Company. The company expects to be in the market March 1 for the following equipment: One 100-hp high pressure return tubular boiler, one simple or compound Corliss engine for direct-connection to a two-phase alternator and one 100 or 150-kw two-phase 60-cycle 2000-volt alternator.

SIOUX CITY, IA.—Claiming that Bills Brothers have failed to comply with their contracts in the matter of making payments for construction material for Sioux City's independent telephone system, the General Engineering Company went into the district court and secured the appointment of E. W. Hammer as receiver for the firm of Bills Brothers. The sum of $50,000 has been deposited with a surety company as surety. Mr. Hammer is the president of the General Engineering Company. The General Engineering Company alleges that Bills Brothers, who have the chief contract for the building of the plant in Sioux City, are indebted to the plaintiff in the sum of $51,657.50. It is declared that the General Engineering Company has already expended the sum of $94,900 for material and $17,040 for labor, making a total of $111,940 and that Bills Brothers have paid on their contract the sum of $60,282.50, leaving a balance due of $51,657.50, which has not been paid.

WAVERLY, KAN.—It was voted Feb. 14 to issue $15,000 bonds for the construction of water works and an electric light plant. W. H. Williams is city clerk.

WICHITA, KAN.—The Merchants' Heating & Lighting Company is to construct an electric light and heating plant at a cost of $300,000. W. H. Scott, Marquette Bldg., Chicago, Ill., is the engineer.

WAVERLY, KAN.—Bids are wanted by W. H. Williams, city clerk, for the purchase of $15,000 bonds to be used for water works and an electric light plant. The engineers are Burns & McDonnell, of Kansas City, Mo. J. C. Fear is Mayor.

NICHOLASVILLE, KY.—It is proposed to purchase one alternating current generator for the municipal plant. C. S. Evans is manager.

DANVILLE, KY.—The Electric Light Committee of the City Council, has received from the National Construction Company, of St. Louis, Mo., plans and specifications for an electric light plant, which it is reported it has the contract to construct in this city. Work will probably begin at once.

PLAQUEMINE, LA.—A charter has been granted to the Plaquemine Electric Light & Power Company, with a capital of $30,000, and with J. H. Savage, M. Dick and V. M. Barber as directors.

PORTLAND, ME.—The Consolidated Electric Light Company of Maine, proposes adding to its plant the following equipment: one 360-kw 3-phase alternating-current dynamo, a 320-kw 110 volt direct-current dynamo, a 1000-hp heater, a 1500-hp condenser and piping. G. E. Raymond, Portland, is secretary.

PORTLAND, ME.—The Porto Rico Power & Light Company has been organized in Portland for the purpose of carrying on business in the island of Porto Rico. Its capital is $750,000, of which $1000 is paid in. The officers are: President, Millard W. Baldwin, of Portland; treasurer, Jas. J. Hernan, of Portland.

AUGUSTA, ME.—The People's Heat & Light Company has been organized at Augusta with $300,000 capital stock, of which nothing is paid in. The officers are: President, M. H. Simmons, of Augusta; treasurer, E. F. Whittum, of Augusta.

SALISBURY, MD.—The Salisbury Light, Heat & Power Company has in contemplation the erection of a boiler house and a thorough rebuilding of its lines this spring. Ralph B. Rhodes is manager.

BALTIMORE, MD.—The United Electric Light & Power Company and the Wenstrom Electric Company are reported to have consolidated under the name of the Consolidated Gas, Electric Light & Power Company. Douglas Burnett is manager.

HOLYOKE, MASS.—It is proposed to add to the municipal electric light plant a 500-kw Curtis turbine and three 250-hp boilers. A. W. Darby is superintendent.

NORWOOD, MASS.—The Norwood Light & Power Company has filed a petition with the selectmen of Norwood, asking the right to erect poles and wires on some 25 streets in the thickly settled portion of this town for the purpose of furnishing electric power for all purposes in the town of Norwood.

PONTIAC, MICH.—A. Jacobs, of Detroit, is interested in the construction of an electric light or gas plant at Pontiac.

GRAND RAPIDS, MICH.—Barney Mayer, superintendent and chief electrician of the municipal electric light plant, has submitted to Council a report of the cost of placing wires underground. He estimates the cost of laying conduits in concrete and building manholes at $21,645 and for cable $11,655. For next year's budget he asks for new circuits $3000; for a new boiler $5500, and for repairs to towers $400.

AUSTIN, MINN.—It is proposed to install at the city electric light plant a 300 or 500-kw alternator with suitable engine or turbine.

WHITEBEAR LAKE, MINN.—The Whitebear Lake Electric Company will construct an underground system at Manitou Island, a distance of one mile. E. A. Bacon is chief engineer.

STURGEON, MO.—The citizens voted Feb. 6 to issue $5000 bonds for an electric light plant. W. A. Seymour is city clerk.

JEFFERSON CITY, MO.—Senator Ely's bill permitting street railways in towns of less than 10,000 inhabitants to buy electric light plants was passed.

HIGBEE, MO.—W. K. Palmer, Kansas City, has been authorized to prepare plans and specifications and superintend the construction of an electric light plant for the Higbee Electric Light, Heat & Power Company.

MEXICO, MO.—As a result of the Mexico Electric Light Company, having refused to enter upon a contract with the city for street lighting, the Council has passed an ordinance granting the company a franchise for 20 years, a special election having been called for February 21 for a ratification vote. In the meantime the city streets are without lights.

ST. LOUIS, MO.—The following-named officers were elected at the directors' meeting of the Union Electric Light & Power Company, Feb. 15. John Beggs, of Milwaukee, president; Julius Walsh, first vice-president; Charles W. Wetmore, second vice-president; Breckinridge Jones, treasurer; Harold P. G. Coates, secretary, and W. V. N. Powelson, general manager.

PASS CHRISTIAN, MISS.—The Town Council has passed an ordinance inviting bids to light the town with electricity.

WELLS, NEV.—Articles of incorporation of the Elko Electric Light & Power Company, with a capitalization of $100,000, have been filed with the County Clerk. The incorporators are A. W. Hesson, John J. Hylton, C. J. Hood, Webster Patterson, W. C. Owens, R. H. Mallett, C. M. Hansel and Charles E. Noble.

KEARNY, N. J.—The Town Council has selected Runyon & Cary, of Newark, to prepare plans for a municipal electric light plant.

HIGHLANDS, N. J.—It is proposed to construct water works and an electric light plant, at a cost of $25,000. No engineer has been selected and the question has not yet been voted upon. P. N. Cornwell is Mayor.

WATKINS, N. Y.—The Village Trustees have selected an engineer to prepare plans for an electric light plant.

ILION, N. Y.—Governor Higgins has signed the bill legalizing an issue of $25,000 bonds for an electric light plant for Ilion.

WATKINS, N. Y.—The electric light plant of the Watkins Consolidated Gas & Electric Light Company was destroyed by fire Feb. 3.

KIRKLAND, N. Y.—The College Hill Electric Light Company, of Kirkland, has been incorporated with a capital of $5000. Directors: C. B. Rogers, of Utica, and Jos. Rudd and S. J. Saunders, of Clinton.

CLINTON, N. Y.—The Franklin Springs Electric Light Company has been incorporated with a capital of $5000 to furnish electricity in Clinton, Kirkland, New Hartford and Marshall. Directors: Fred. DeW. Smyth and Delos DeW. Smyth, of Utica, and Edward Stanley, of Clinton.

HOLLEY, N. Y.—The Albion Power Company has made a proposition to purchase the plant of the Holley Municipal Electric Light Company, and offers to supply light and power at a lower figure than is now charged. The Albion Company proposes to expend $15,000 in the purchase of the plant.

ASHEVILLE, N. C.—The charter of the City of Asheville has been amended so that the city may establish an electric light plant.

NEW BERN, N. C.—The city of New Bern will fight the proposition to sell the lighting and other public properties unless the issue be first submitted to the people.

ANDREWS, N. C.—The Andrews Light & Power Company has been incorrated with $100,000 authorized capital. J. Q. Barker, E. C. Henneman and others, of Andrews, are interested.

GRAHAM, N. C.—Plans are being prepared by H. A. Pressey, Washington, D. C., for water works, an electric light plant and ice plant for Graham. Bids will probably be called for about March 1.

MORGANTON, N. C.—Mr. H. L. Miller, of Morganton, having secured a franchise from the town of Oxford, N. C., last fall, has commenced work on a new light, water and ice plant which will be operated by the Southern Public Service Corporation of Washington, D. C.

SYDNEY, N. S.—The Dominion Iron & Steel Company, of Sydney, is about to instal new electrical appliances in connection with practically every department of the company's works. The company's entire electrical department will be reconstructed.

BELLEFONTAINE, OHIO.—This city expects to entirely rebuild, this summer, its municipal plant with a bond issue of $50,000. C. W. Buchanan is manager.

CINCINNATI, OHIO.—Capt. McGuire has submitted to the Board of Public Service an estimate recommending an expenditure of $40,000 for an electric lighting plant at the new workhouse and for other work.

MIDDLETOWN, OHIO.—The street lighting contract has been signed with the Middletown Electric Light & Power Company. The company will install 113 arc lights and charge therefor $60 per year per light, or a total of $6780 per year. The contract runs for 10 years.

NILES, OHIO.—The City Light & Water Works contemplates changing its street lightng from direct current open arcs to alternating current enclosed arcs; also to install either a 300-kw turbine or a direct-connected engine and generator, and a new feed water heater.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company intends to dispose of all its horses used now in handling its construction, supply and repair wagons and will operate the wagons with electric motors. The automobile wagons will be operated with storage batteries with a capacity of 70 miles.

ANADARKO, OKLA.—The City Council of Anadarko has awarded the contract for the lighting plant to the Union Light & Power Company of El Reno, Okla. The contract price was $10,455. The plant will be installed in connection with the waterworks, using the same building, boilers, and will be under the same management.

STROUD, OKLA.—A charter has just been issued to the Stroud Light & Power Company, of Stroud, with a capital of $15,000. Stockholders: A. H. Sherwood, Lee Patrick and others, all of Stroud.

BROWNSVILLE, PA.—The Brownsville Light, Heat & Power Company proposes installing a 250-hp engine and a 200-kw generator. J. M. Bell is manager.

BRIDGEPORT, PA.—The Norristown Electric Light Company, of Norristown, has secured the contract for lighting the streets by electricity at $70 per lamp per year.

MT. UNION, PA.—Scott Dibert, president of Mt. Union Silica Brick Company, has secured a franchise for the construction of an electric light plant to light the brick works and the town.

LINFIELD, PA.—The Linfield Electric Light Company has been incorporated with a capital of $5000. Directors: Horace Ashenfelter, Royersford, G. E. Brownback, Linfield, and others.

TURTLE CREEK, PA.—The Rose Electric Light & Power Company, of Turtle Creek, has been organized with a capital of $20,000 to erect a power plant to supply Turtle Creek and adjoining boroughs with light and power. William L. Ledger is president.

WEST SCRANTON, PA.—An application is about to be made to the governor for a charter for the West Scranton Light, Heat & Power Company, by Wm. T. Davies, John H. Williams, Herbert L. Taylor and others. It is understood that the company proposes to operate mainly in West Scranton.

MIDDLEBURG, PA.—Geo. W. Wagenseller, of Middleburg, and David Goldstein, of Pittsburg, are stated to have secured a franchise for the construction of a power plant on Middle Creek below Selinsgrove. A company with a capital of $50,000 will be incorporated, and the power developed and transmitted in Snyder County.

CATASAUQUA, PA.—Among the improvements contemplated to the Lehigh-Northampton Gas & Electric Company, which is now in the hands of a receiver, are the following: one 300-hp boiler, one 250-kw generator and one 150-kw generator; one condenser, one feed water heater, one feed pump, one oil separator, switchboards, etc., and to change lines in Catasauqua, Coplay and Alliance.

PALMYRA, PA.—The Palmyra Gas & Electric Company has been incorporated for the purpose of supplying light to the village of Palmyra. The company is to take over the property of the Palmyra Gas Light Company and the Palmyra Electric Light & Power Company. The new company is capitalized at $25,000 and the directors are Carlton C. M. Hunt, Charles McLouth, Palmyra; Charles A. Schwar, Hornellsville; George S. Sheppard, William T. Morris, Penn Yan.

WICKFORD, R. I.—Harry S. Dixon has sold his electric light system to the Wickford Light & Power Company and that company will hereafter furnish the lights for the village. Arrangements have been made by the new company to secure power from the Sea View Railroad Company.

BRANCHVILLE, S. C.—G. M. Noble, city clerk, writes that bids are now being received for an electric light plant and telephone exchange to cost about $6000.

DARLINGTON, S. C.—A representative of a Philadelphia concern, which has bought the Darlington light and power plant, has made a proposition to the town of Timmonsville, S. C., which, it is said, will likely be accepted, the proposition being for the establishment of an electric lighting system.

MONTROSE, S. D.—Mr. Mart Donahue and Mr. P. G. Williams are interested in an electric light plant being started in this place.

PULASKI, TENN.—It is proposed to purchase a larger engine and dynamo for the municipal electric light plant. C. H. Brown is superintendent.

COOKEVILLE, TENN.—Bonds to the amount of $25,000 have been sold to be used for the construction of water works, an electric light plant and street improvements.

TEXARKANA, TEX.—The Street Railway Company will build an electric light plant and power house in the immediate future. Col. E. J. Spencer is superintendent.

SALT LAKE CITY, UTAH.—James J. Chalmers, representing eastern capitalists, has filed on the water of Big Cottonwood and Little Cottonwood Creek near this city, the intention being the installation in that vicinity of an electric power plant.

CAPE CHARLES, VA.—The town of Cape Charles has advertised an electric lighting franchise, the bids to be in by about March 6.

FREDERICKSBURG, VA.—This city expects to add to the municipal plant next year an incandescent and power circuit, 3-phase, 60 cycles. E. M. Greene is manager.

FARMVILLE, VA.—This town is in the market for one 250-hp engine, one 200-kw alternating current generator, 35 enclosed arc lamps switchboard, etc., for its municipal electric lighting plant. H. K. Bullock is superintendent.

SNOHOMISH, WASH.—The Snohomish Electric Light & Water Power Company proposes extending its system to Machias and out in the rural districts. C. Cleaner is chief engineer.

SEATTLE, WASH.—City Comptroller Riplinger is about to ask for bids for $250,000 bonds to be used for extending the municipal electric light service to the residence districts of the city.

SPOKANE, WASH.—Press reports state that the Washington Water Power Company will soon increase its capital to $5,000,000 to cover the expenses of extensions and improvements. In addition to the Port Falls, Idaho, power plant contract which has been let to Nelson Bennett, of Tacoma, it is proposed to extend the line to Medical Lake at a cost of about $300,000 and also build between 2 and 3 miles of extension within the city limits. Mr. D. L. Huntington, Spokane, Wash., is manager.

STURGEON BAY, WIS.—This city expects within a year or two to rebuild its municipal electric light plant. Jas. E. Johnson is manager.

MINOCQUA, WIS.—John Woodloch, of Merrill, owner of the electric light plant at Minocqua, has in contemplation the rebuilding of the plant next summer, to include a dam, water wheels, a dynamo and a new line 5 miles in length.

The Electric Railway.

BIRMINGHAM, ALA.—The annual meeting of the Birmingham Railway, Light & Power Company was held recently and the recommendation of engineers for the expenditure of $700,000 this year was ratified. Directors were chosen and they in turn re-elected the officers of the company with Robert Jemison, president; J. A. Emery, vice-president and general manager; secretary, J. P. Ross; vice-president, A. H. Ford, and treasurer and auditor, C. O. Simpson. Extensive improvements of the plant of the company are contemplated.

LOS ANGELES, CAL.—The citizens of National City, San Diego County, propose to construct an electric railway connecting that town with the city of San Diego. A committee comprising Dr. E. M. Ely, Postmaster S. S. Johnson, J. A. Rice and W. S. Hill, has the matter of route, franchise and grading in hand.

HARTFORD, CONN.—The Connecticut Legislature has been requested to authorize an increase in the limit of the capital stock of the Hartford Street Railway from $2,000,000 to not exceeding $5,000,000, to provide from time to time for extensions, improvements, additions, etc.

AUGUSTA, GA.—Suit has been filed at Trenton, N. J., to set aside two voting trusts of the Augusta-Aiken Electric Railway, operating the lighting and street railway systems of Augusta. The complainants, it is said, charge general mismanagement. They ask that the list of stockholders be revised so that all stock shall stand in the name of the actual owner. An order was also filed on February 6 enjoining the holding of the annual stockholders' meeting scheduled for the date above mentioned.

ROCKFORD, ILL.—The Rockford Belt Railway Company, principal office Chicago, has been incorporated, with a capital of $100,000, to construct a belt railway in the city of Rockford. William F. McSwiney, Frank M. Clark, Benjamin H. Harris, all of Chicago, and John C. Duffin, of Dekalb, Ill., are interested.

JASPER, IND.—It is announced that the Jasper & Vincennes Traction Company has signed contracts for the construction of a power house at this point.

HARTFORD CITY, IND.—The Union Traction Company will build its central car shops in this city, having taken an option on an 80-acre tract on the east side.

HUNTINGTON, IND.—Huntington Township is reported to have voted a $25,000 subsidy to the Huntington, Columbus City & Northwestern Traction Company, which proposes to build to Goshen.

TERRE HAUTE IND.—The Terre Haute Traction & Light Company has placed an order for a 250-kw generator to take the place of the equipment destroyed in the recent power-house fire.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has decided to enlarge the power station at Huntington. A large power plant is said to be contemplated for this city later on.

MARION, IND.—The Board of Commissioners has granted a franchise to the Geneva Traction Company to build an electric railway from Marion, Ind., to Celina, Ohio. Silas W. Hale is president and A. G. Briggs, secretary.

TERRE HAUTE, IND.—A meeting was held in this city of delegates from points in Indiana and Illinois to promote a traction road over the 70 miles intervening. A committee was appointed to formulate a plan and report to a mass convention to be held at Robinson, Ill., Feb. 27.

PETERSBURG, IND.—The Vincennes & Jasper Traction Company has completed a survey of its line, and stakes have been set. The contract for the construction of the power house in this city has been let to the Cincinnati Construction Company for $72,000. The power house is to be completed by July 1.

LOGANSPORT, IND.—The Standard Oil Company is asking for a right of way through Flora, Binghurst, Reekfield, Idaville and Monon, for the purpose of building an electric railway. It is said to be part of a scheme to build a traction line from Chicago to Indianapolis. The territory named is to form the middle link.

WABASH, IND.—The Fort Wayne & Wabash Valley Traction Company have authorized a bond issue of $1,000,000. The securities will be a first and second lien on the Fort Wayne & Southwestern and the Wabash lines, respectively. The proceeds will be used to build a large central power house either in Fort Wayne or Huntington.

HUNTINGTON, IND.—The electors of Clearcreek township, Huntington County, have voted a $5000 subsidy in aid of the Huntington, Columbia City & Northwestern Traction Company which proposes to build a line from Huntington to Goshen. Several other townships will vote on the subsidy proposition for this road in a short time.

INDIANAPOLIS, IND.—A bill has been introduced in the Legislature to compel interurban companies to build waiting stations along their lines at cross roads—practically one station in each mile. The companies are fighting the measure and insist that such a law could not be enforced as stations are not needed every mile along their lines.

INDIANAPOLIS, IND.—The Indianapolis, New Castle & Toledo Electric Railway Company has filed articles of incorporation with the Board of Public Works, in accordance with recent request, showing that its authorized capital stock is $3,500,000, with $15,000 paid up. This company is asking for an independent entrance to this city. This request is being opposed by the local street railway company.

INDIANAPOLIS, IND.—A bill to make it unlawful to vote a subsidy in aid of a railroad company, including electric railway companies, is likely to become a law. The bill was ordered advanced by a decided vote, notwithstanding able argument to let the people decide for themselves in such matters.

It was shown that communities could obtain electric lines in no other way, and this bill deprived them of the right to do so.

LOGANSPORT, IND.—A subsidy election has been ordered in Bethlehem township to vote on a two per cent. subsidy in aid of the South Bend & Logansport traction line. The promoters are hastening the matter and desire to get it out of the way before the law recently enacted repealing the subsidy law goes into effect. Meetings are to be held in Plymouth March 25 and in Walnut Township April 1, for the same purpose.

GRINNELL IA.—The Grinnell Interurban Railway Company has been organized by J. P. Lyman, O. K. Cole and R. M. Haines. The following officers were elected: O. K. Cole, president; B. J. Carney, vice-president; E. B. Brander, secretary; C. W. H. Beyer, treasurer. The object of this organization is to do the preliminary work of getting right of way and franchises, making surveys, etc., such as are necessary before financing the project and building the road. The capital stock of the company was fixed at $10,000.

INDIANAPOLIS, IND.—Arrangements have been made by the Indianapolis & Northwestern Traction Company, the Columbus, London & Springfield, the Columbus, Buckeye Lake and Newark traction lines in Ohio, and the Clover Leaf Railroad whereby passengers may be transferred from one line to another in points in Ohio east of Dayton. Arrangements are also about completed whereby passengers may go from this city to Frankfort by trolley, thence to Toledo over the Clover Leaf and then to Cleveland, Sandusky and various other Ohio points, by traction lines out of Toledo. The arrangements now in vogue between Dayton and St. Louis require but two changes—one at Indianapolis and one at Frankfort.

PADUCAH, KY.—Jefferson Read and J. J. Freunditch, promoters of the proposed interurban railway from Paducah to Cairo, Ill., have gone to New York to negotiate the loan to build the road. The entire right of way has been secured, and the company hopes to get work started early the coming spring. The estimated cost of the building of the road is $600,000, and Eastern capitalists have agreed to take the company's bonds. A right of way into Paducah was secured last week. The Paducah-Cairo line will be 34 miles long.

WESTFIELD, MASS.—The Hampden Contracting Company, capitalized at $25,000, has been organized to build the new line of the Western Massachusetts Street Railway from Westfield to Lee.

WORCESTER, MASS.—Authority to issue additional capital stock of $200,000 to cover the purchase of the Worcester, Rochdale & Charlton Depot Street Railway Company, is asked in a petition to the Railroad Commissioners by the Worcester & Southbridge Street Railway, both roads having been acquired by the New York, New Haven & Hartford Railroad.

WARE, MASS.—The Hampshire & Worcester Street Railway Company, for which a receiver was appointed a few weeks ago, is to be sold at auction, according to a report here. The operation of the road has been suspended and residents of the towns along its route are signing a petition that operation be resumed and that double fare be charged in order to meet the deficiency in running expenses.

LEXINGTON, MISS.—The Durant-Lexington Electric Railway has been organized, and will be soon chartered. The contract for construction has been let to the Louis Monteville Construction Company, of Mississippi. Chester Jones and W. O. Glines, of Durant, are interested.

ST. LOUIS, MO.—Stockholders of the St. Louis & Suburban Railway Company have given assent to the proposition to increase the capital stock of the company to $4,500,000, the $1,500,000 additional stock to be taken from the authorized unissued stock. The company proposes to expend the revenue to be thus derived to improvements. The stock has been underwritten, and the company will have about $900,000 to expend for this purpose.

JOPLIN, MO.—Several miles of electric railway are to be built throughout Southwest Missouri during the coming summer. Surveyors are now in the field making a survey for an electric railway from Webb City to Carthage. This line will be 15 miles in length. The right of way has been purchased and the profiles made for an electric railway from Galena, Kan., through Lowell to Baxter Springs. This road will be 10 miles in length, and is being built by the Spring River Power Company, which recently built a dam across Spring River at Lowell, at which place power will be generated.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has signed an order authorizing Edwin C. Foster and C. Wright as receivers of the New Orleans Railways Company to issue receivers' certificates to the amount of $500,000. The money is to be used for the purpose of betterments and equipment.

BROOKLYN, N. Y.—The State Railroad Commission announces that it will recommend the construction of a temporary loop terminal at the Manhattan end of the Williamsburg Bridge. The commission will also recommend important changes in the administration of the Brooklyn Rapid Transit. It is said that the loop suggested would enable passengers to be carried into Brooklyn at the rate of 84,000 an hour. A permanent loop could be built in 18 months at a cost of $3,000,000.

BROOKLYN, N. Y.—The board of directors of the Brooklyn Rapid Transit Company has elected officers for the ensuing year as follows: A. N. Brady, chairman of the board; Edwin W. Winter, president; T. S. Williams and H. C. DuVal, vice-president; C. D. Meneely, secretary and treasurer, and Sheehan & Collins, general counsel. For the operating department these men were re-elected: General manager, J. F. Calderwood; general superintendent, D. S. Smith; superintendent of surface lines, W. B. Graham; mechanical engineer, R. C. Taylor; electrical engineer, C. E. Roehl; engineer of way and structure, H. S. Wilgus; general attorney, G. D. Yoemans; claim agent, I. Isaacsen; purchasing agent, L. Van Cott; real estate agent, O. Harriman.

SYRACUSE, N. Y.—The Rochester, Syracuse & Eastern Railroad Company, which is building an 80-mile double track electric railway between Rochester and Syracuse, N. Y., has just let contracts which call for the completion of the first 36 miles of the road, from Rochester to Clyde, by the middle of November of this year. The two latest contracts are those to J. G. White & Company, of New York, for the laying of track, and to J. M. & C. G. Buckley, of Worcester, Mass., for the construction of the power house at Lyons, the latter to be completed by July 1. The Westinghouse Electric & Manufacturing Company recently received a contract aggregating $300,000 for the electrical equipment of the power house, sub-stations and rolling stock, which has not yet been bought.

NEW YORK, N. Y.—The syndicate which proposes to make application to the Rapid Transit Commission for a tunnel under Third Avenue and the Bowery and along the east side to the Battery, touching the financial section, is believed to be affiliated with Metropolitan Street Railway. The prime mover in the scheme is the New York Railroad & Development Company in which Mr. William G. Gottshall, president of the proposed New York & Portchester Railroad is a director and a leading spirit. Mr. Gottshall, it is understood, is on very friendly relations with Thomas F. Ryan, while John B. MacDonald, the builder of the Interborough Rapid Transit line, who recently resigned from the latter company in order to enter Metropolitan Securities, is also associated with the scheme.

ASHEVILLE, N. C.—A bill has been introduced for the incorporation of the Cherokee, Spartanburg and Union electric railway to connect these South Carolina towns with Asheville, N. C., and other summer resorts. A. N. Wood and State Senator T. B. Butler, of Gaffney, S. C., are among those interested. the capital stock being placed at $250,000.

LORAIN, OHIO.—The Lorain Street Railway Company is planning to establish a summer park near this city.

CANTON, OHIO.—The Canton-Akron Railway Company will establish a sub-station at Massillon, placing in it a 300-kw rotary. It is stated that a large turbo-generator will be placed in the main power station.

WOOSTER, OHIO.—Col. C. V. Hard, of this city, is again pushing the promotion of the Cleveland, Ashland & Mansfield Railway. W. H. Abbott, of the Roberts & Abbott Company, Cleveland, is doing the preliminary work.

COSHOCTON, OHIO.—The Zanesville, Coshocton & New Philadelphia Traction Company, of Coshocton, has been incorporated by John W. Cassingham, Wilber F. Stanley, George C. Hay, Harry C. Ferguson, J. S. Bennet and J. A. Hanlon.

TOLEDO, OHIO.—The Toledo & Indiana Railway, which is building an extension to Bryan, is considering the extension of the road from Bryan to Fort Wayne, Ind. The Patrick Hirsch Construction Company, of Toledo, is doing the construction work.

STEUBENVILLE, OHIO.—A company has been formed by D. H. Sinclair, Cyrus Ferguson, J. T. Douglas and others of Steubenville, to build an electric railway from Steubenville to Wellsburg, W. Va. The company expects to let contracts in the near future for the building of the road.

NEW LEXINGTON, OHIO.—Edward S. Martin, of New Straitsville, is quoted as stating that he has completed arrangements for the financing of the Perry Electric Railway, Light & Power Company, which proposes to build an electric railway from New Straitsville to Zanesville by way of New Lexington.

COSHOCTON, OHIO.—The Zanesville, Cambridge & Northern Traction Company has been incorporated by S. A. Weller, E. C. Rinner, Frank McCormac, Sam H. Nichols, Lloyd Wine, C. H. Garver, R. C. Burton and Colin McDonald. Capital stock $10,000. The company proposes to build an electric railway from Zanesville to Cambridge and Coshocton.

COLUMBUS, OHIO.—The Columbus Railway & Light Company held its annual meeting recently and re-elected the present directors and officers. The report of the company indicated that the gross earnings for last year were about $1,800,000, the railway earnings being about $1,400,000, the increase of gross earnings being about 7 per cent. over the earnings of the previous year. The Company used about 49 per cent. of receipts for operation.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company has closed contracts for the equipment for its permanent power house, which will be located at Port Clinton or Oak Harbor. The Allis-Chalmers-Bullock combination will furnish the complete steam and electrical equipment, which will consist of two 800-hp generators and engines and four 400-hp Erie City boilers. The plant is to be completed by July 1. At present the company has a temporary power station at Genoa using inverted rotaries. The sub-station is at Oak Harbor. Under the permanent arrangement, the Genoa station will be made a sub-station and another will be installed in a car, using it as a floater.

TAMAQUA, PA.—Preliminary surveys are under way for the extension of the Tamaqua & Lansford Street Railway from Tamaqua to Middleport.

ELIZABETHTOWN, PA.—Councils have passed the ordinance granting a franchise to the Philadelphia, Lancaster & Harrisburg Electric Railway Company.

HARRISBURG, PA.—A charter has been granted to the California Street Railway Company, capital $25,000, to build an electric railway in California, Washington County.

JEANNETTE, PA.—The Jeannette, West Newton & Monongahela Valley Street Railway Company has given the contract for the building of a line from Jeannette to West Newton to the New England Engineering Company, of Waterbury, Conn. The line will be about 13 miles long.

KNOXVILLE, PA.—The Fountain City Railway, with all of its equipment, has been sold at public auction for $20,000, and the Fountain City Land Company's holdings of 600 acres located at Fountain City have been sold for $15,00. The property was bid in for M. J. Strain, of New York, a representative of Geo. Borgfelt & Company, of that city, which company held a $350,000 lien on the property.

PHILADELPHIA, PA.—The board of directors of the Philadelphia Rapid Transit Company has sold to Drexel & Company an issue of $10,000,000 4 per cent. bonds at par. They are 50-year first mortgage bonds upon the property of the Market Street Electric Railroad Company, and are guaranteed by the

Philadelphia Rapid Transit Company. There will be turned over to the company for immediate use for the building of the elevated and underground system $5,000,000, and the balance as required from year to year for the extension of the lines.

CHICAGO, ILL.—A meeting of the stockholders of the Chicago City Railway Company was held here Feb. 16. It is stated that Thos. E. Mitten, general manager of the International Traction Company of Buffalo, will be elected first vice-president to take the active management of the Chicago City Railway. This latter company was recently purchased by a syndicate which proposes to consolidate all of the Chicago street railways.

CHARLESTON, S. C.—The Charleston & Summerville Electric Railway Company has effected a permanent organization by the election of the following officers: Ogden Edwards, of Troy, Ohio, president; Robert Janvier Smith, of Summerville, vice-president and general manager; E. P. Guerard, of Charleston, secretary and treasurer. The company is capitalized at $100,000, with the privilege of increasing its capital stock to $1,000,000.

SAN MARCOS, TEX.—A meeting was held here by the citizens a few days ago and $1,750 was raised to commence work on the San Marcos Valley Electric Railroad. An organization was perfected as follows: A. L. Davis, president; J. H. Jennings, first vice-president; A. K. Lipscomb, of Luling, second vice-president; J. T. Blanks, treasurer, and Judge B. G. Neighbors, secretary. Contracts for temporary and permanent surveys have been let.

RICHMOND, VA.—The courts, after lengthy discussion of the matter, have decided that the Richmond and Chesapeake Bay Railway may be chartered, this being the company in which Mr. Gould is interested, proposing to build a line to be operated by steam or electricity from Richmond to a point on the Chesapeake Bay.

WHEELING, W. VA.—The Stillwater & Wheeling Valley Traction Company proposes to build from Uhrichsville, Ohio, to Pasco, to connect Canton, Ohio, with Wheeling. Dr. J. A. Hobson is president of the company.

SPOKANE, WASH.—The Spokane Traction Company has been petitioned by citizens of Peaceful Valley to extend its line into that territory.

WHEELING, W. VA.—Surveys are being made in the interest of the proposed electric railway between Wheeling and Canton. Edward Hobson, of Flushing, is interested.

CHILLIWACK, B. C.—The Chilliwack Light & Power Company, of which J. B. Morgan is manager, is planning to commence work early in the spring on its power plant and electric railway, the latter to extend from Chilliwack to New Westminster. The power plant and transmission line is estimated to cost $125,000.

PARA, BRAZIL.—The street railway system of Para has been purchased by an English syndicate. The names of the contractors, who will install a modern system of electric traction, are not yet known.

WINNIPEG, MAN.—The City of Winnipeg for the year 1904 received over $20,000 as its five per cent. share of the electric street railway earnings. The gross earnings of the company for 1904 were $407,542. The 5 per cent. tax for the city levied on the gross earnings realized the sum of $20,377.

OTTAWA, ONT.—A bill to incorporate the St. Mary's & Western Ontario Railway Company has been reported to Dominion parliament by the railway committee. The company has a capital stock of $1,000,000 with the head office at St. Mary's. Authority is given the company if it be deemed advisable, to operate by electricity, to generate power for the operation of the railway and to dispose of surplus power.

New Industrial Companies.

THE CHARLES N. WOOD ELECTRICAL COMPANY, of Boston, has been formed with $5000 capital. President, Charles N. Wood; treasurer, Walter E. Geer.

THE FACTORY POWER COMPANY, of Worcester, Mass., has been formed, capital stock $20,000. President, George A. Goddard; treasurer, Charles S. Goddard.

THE WESTERN WATER & ELECTRIC COMPANY, of Madison, N. J., has been incorporated with a capital stock of $100,000. The incorporators are Chas. E. W. Smith, Geo. M. Ward and John H. Gindrat.

THE WATER POWER SECURITIES COMPANY, of New York City, has been incorporated with a capital stock of $100,000. The incorporators are S. B. Lawrence, H. C. Everdell and N. F. Lenssen, New York.

THE NASH ENGINEERING COMPANY, of New York City, has been incorporated with a capital stock of $50,000. The directors are Lewis H. Nash, Brooklyn; Henry S. Morton and Quincy L. Morton, Hoboken.

THE STERLING MANUFACTURING COMPANY, of Sterling, Conn., has been formed, capital stock, $50,000, to commence business with $1000. Incorporators: L. B. Penfield, F. W. Baker, M. J. Hogan, all of Hartford.

THE COMMERCIAL ELECTRIC VEHICLE COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $1,000,000. The incorporators are Dwight W. Bowles, Thomas P. Ford and Frank P. Slade.

THE PEER AUTOMOBILE COMPANY has been organized at Chicago for the manufacture and repair of automobiles. The new company has been incorporated by Godfrey Johnson, Charles Stilwell and C. C. Bowersock.

THE NASSAU ILLUMINATING & POWER COMPANY, of North Hempstead, N. Y., has been incorporated with a capital stock of $100,000. The directors are William B. Hord, W. H. Noyes and Jesse Stearns, New York.

THE NIAGARA PACHOMETER & INSTRUMENT COMPANY has been incorporated with a capital stock of $200,000 at Niagara Falls, N. Y. The directors of the company are C. R. Huntley, A. H. Hinman and G. J. Howard,

THE GRA-RICH COMPANY, of Cleveland, Ohio, has been formed with $10,000 capital to manufacture electrical appliances. Charles G. Graham, Louis C. Richmond, E. C. Bodenhoff, Henry J. Hunger and Charles S. Beardsley are the incorporators.

THE CLARK ELECTRICAL ENGINEERING COMPANY, of Detroit, Mich., has been incorporated with $20,000 capital stock, of which $10,000 has been paid in, covering patents, etc. The stockholders are Agnes J. Clark, Ole E. McLaughlin and Gowas A. Clark

THE FIRE PROTECTION ENGINEERING & EQUIPMENT COMPANY has been incorporated at New York City with a capital stock of $10,000. The directors of the company are Joseph S. Frelinghuysen, Ernst R. Clayton and Laurens R. Bowden, New York.

THE BEESLEY, BENN & LEHMAN MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $40,000, to manufacture mechanical and electrical appliances. The directors are James Beesley, Brooklyn; Louis F. Benn, Bayonne, N. J., and Joseph A. Lehman, Roselle, N. J.

THE INTERNATIONAL ELECTRICAL APPLIANCE COMPANY has been organized at Augusta, Me., for the purpose of dealing in electrical appliances. Capital stock $50,000, of which nothing is paid in. The officers are: President and treasurer, I. L. Fairbanks, of Augusta.

THE PHILIPPINES PRODUCTS COMPANY, of Byram, N. J., has been incorporated to deal in Philippine products and to build and operate gas and electrical works, docks, bridges, etc. The capital stock is $100,000, and the incorporators are Franklin G. Colby, Eustace Conway, Herbert Hellis and James H. McGuffie.

THE INDIANA SCHOOL OF TELEGRAPHY has been incorporated at Elkhart, Ind., with a capital stock of $10,000. The object of the company is to establish a school and teach telegraphy in all its branches. Jno. E. Neusbaum and B. W. Butler, of Elkhart, and C. S. Rhoades, Indianapolis, are the incorporators and instructors.

THE ALASKA FUEL, LIGHT & TRANSPORTATION COMPANY, with an authorized capital of $1,000,000, has been incorporated at Trenton, N. J. The company is to do a mining business and produce electricity, motor power, heat and light. The incorporators are W. R. Duval, of Allenhurst, N. J., and J. Warren Dickson and A. C. Shenstone, of New York.

Legal.

ABANDON EDISON NAME.—The Edison litigation in the United States Court at Washington between Thomas A. Edison vs. the Thomas A. Edison, Jr., Chemical Company, has been discontinued by mutual consent on the filing of an agreement in which the defendant company agrees to abandon the use of the name "Edison" in its corporate title and as a signature.

THE AMERICAN ELECTRIC FUSE COMPANY, in a decision handed down Feb. 4 by a Michigan Court has been confirmed in its sole rights of manufacture of the Rolfe self-soldering fuse. This right was secured by contract with the owner of the patents on the fuse, which contract the court decided has not been forfeited by alleged lapses given as a reason by the defendent for entering into contract with another party for the manufacture of the fuse.

UNITED ELECTRIC COMPANY STOCK.—The argument was ended last week before Vice-Chancellor Garrison, at Jersey City, on the question of jurisdiction of the Court of Chancery in the suit instituted by Adam Groel to compel the United Gas Improvement Company of Philadelphia to return $20,000,000 par value of the stock of the United Electric Company, or its equivalent in cash, put at $6,000,000, alleged to have been appropriated without consideration at the time it promoted and caused the formation of the United Electric Company. The closing argument was made by Counsellor R. V. Lindabury, who maintained that the United Gas improvement Company had closed out its business in New Jersey and was no longer amenable to the courts of the State. Counsel on both sides will submit briefs. The merits of the complaint were not entered upon, as the question of jurisdiction must first be disposed of.

Educational.

PURDUE UNIVERSITY.—Three lectures for the students at Purdue University are scheduled, the lecturers being Dr. F. A. C. Perrine, Wm. Barclay Parsons and Henry R. Towne, the latter of the Yale and Towne Company.

ENGINEERS' MEETING AT TROY.—A meeting of the Society of Engineers of Eastern New York was held in Troy, on Feb. 15. The meeting was preceded by an informal dinner at the Rensselaer Hotel. After the dinner the members listened to a very interesting paper on the subject of "Modern Ordnance," which was presented by Capt. Odus C. Horney, of the Ordnance Dept., U. S. A., now stationed at the Watervliet Arsenal. At the business meeting previous to the presentation of the paper 36 new members were elected, bringing the membership of the society up to 175. The nominating committee presented the following names for officers for the year beginning April 12th: President, Prof. O. H. Landreth, Union College, Schenectady; vice-president, Capt. Odus C. Horney, Ordnance Dept., U. S. A., Watervliet; treasurer, W. I. Slichter, General Electric Co., Schenectady; member finance committee, J. A. Kinkead, American Locomotive Co., Schenectady; member executive committee, F. E. Crane, City Engineer, Amsterdam. These officers will be elected at the annual meeting which occurs April 12th, 1905.

Obituary.

MR. F. COOK.—Mr. Frederick Cook former Secretary of State, was found dead in bed at his home in Rochester, N. Y. Mr. Cook was born in Wildbad, Germany, Dec. 2, 1833, and went to Rochester at the age of 15 years. He started in life as a brakeman on the New York Central Railroad. At the time of his death he was president of the German-American Bank, the Rochester Telephone Company, and the Rochester Street Car Company. He was active in Democratic politics and was elected Secretary of State in 1885. His death was due to apoplexy.

MR. S. L. BARRIETT.—The death occurred suddenly a few days ago at Dayton, Ohio, of Mr. S. L. Barriett, of Cincinnati and formerly of New York. Samuel L. Barriett was an electrical expert and inventor of note. During the war with Spain his inventions in the line of improvements for ordnance were utilized by the Government, and Barriett was employed at a large salary superintending work at United States arsenals. He resigned to go to Cincinnati to organize a company to manufacture and handle other of his inventions. An electrical contrivance which made possible the manufacture of "electric seal" for women's wraps is said to be one of his inventions. He brought out a number of different types of electric motor.

MR. ALBON MAN, the well-known lawyer, soldier and inventor, died a few days ago in Brooklyn. He was a man of great force and originality. His services to the St. Regis tribe of Red Indians caused them to make him a chief. He fought bravely in many of the engagements of the Civil War and was a major in the Federal army. His scientific proficiency won for him from Union College, the degree of doctor of philosophy. He was closely associated with William E. Sawyer in the work of that erratic genius on the incandescent lamp, and to this day one of the best known lamps bears the designation of Sawyer-Man; the patents of the two men being also the cause of some of the most brilliant and notable fights in electrical patent litigation. For a long time Mr. Man was president of the Lincoln Club of Brooklyn. The body has been taken for interment to Malone, N. Y., Mr. Man's native place.

MR. F. M. SMITH.—Mr. Fred M. Smith, one of the oldest pioneers of Alaska, died at Seattle, on February 9, at the age of 58 years. He superintended the construction of a Western Union telegraph line in Alaska in 1865. The line started at New Westminster, and was intended to go to Bering Straits. A cable was to be laid across the straits to connect with a line being built by the Russian government. The Alaska line was abandoned when the Atlantic cable was laid. Mr. Smith again went to Alaska in 1869 for a fur company. He was the man who first reported to the United States Government that Fort Yukon, then occupied by the British, was on American soil, and his contention was later confirmed. That same year he made a trip with dog sleds from near the mouth of the Tanana River to Fort Yukon, a distance of 500 miles. From 1878 until 1884 he was United States collector of customs at Unalaska.

MR. N. P. OTIS.—Congressman Norton P. Otis, chairman of the board of directors of the Otis Elevator Company, died on February 20 at his home in Yonkers. He had been ill for months, and for three weeks had kept to his bed. A widow and eight children survive him. Mr. Otis was a member of the Westchester Historical Society and of the Merchants', Central, Fulton and Engineers' Clubs, and of the Metropolitan Museum of Art of this city. Sixty-five years ago he was born in Halifax, Vt. Elisha G. Otis, his father, was the inventor of the Otis elevator, and the son learned the trade. With a brother he assumed management of the little factory in 1851, and the enterprise is now one of the largest in the country. Norton P. Otis was made president of the company in 1890. Mr. Otis was elected Mayor of Yonkers as a Republican in 1880; State Assemblyman in 1883; was a candidate for Congress in 1900, and was elected from the Nineteenth District in 1903. He was president of the New York Commission to the Paris Exposition.

Personal.

MR. MARTIN P. RICE, head of the Publication Bureau of the General Electric Company, at Schenectady, N. Y., has just sailed on a trip to Europe.

DR. H. V. HAYES has been recommended by a number of prominent members of the American Institute of Electrical Engineers as a good nomination for manager at the ensuing election.

PROFESSOR HENRY PERKINS, of the department of physics of Trinity College, Yale, lectured recently before the Westinghouse Electric Club, of Wilkinsburg, on "Radium."

MR. ANDREW CARNEGIE has taken up literary work again, and is writing a life of James Watt, whose birthday fell on January 19. Mr. Carnegie has long made a patient and enthusiastic study of the work of the great inventor. The book is nearly ready.

MR. CHAS. W. CROSS, M. E., E. E., formerly of the Roberts & Abbott Company, consulting engineers of Cleveland, O., and later electrical engineer for the Eastern Ohio Traction Company, has entered the employ of Crocker-Wheeler Company, of Ampere, N. J., and is attached to the Cleveland office of the company at 816 New England Building.

DR. F. A. C. PERRINE, who as president of the Stanley Electric Mfg. Co. has been living for some years past at Pittsfield, Mass., where the factories are situated, is to move to Plainfield, N. J., and take up his family residence there, thus bringing him into greater accessibility to New York, where he has a large professional practice as a consulting electrical engineer.

MR. THOMAS E. MITTEN has been elected first vice-president of the Chicago City Railway Company and will, on March 1, assume full charge of the property. Mr. Mitten has been, since 1901, general manager of the electric railway properties controlled by the International Railway Company in Buffalo and vicinity. As has already been announced the Chicago City Railway Company has been purchased by a syndicate for the purpose of consolidating all of the street railway lines in Chicago under one management.

MR. H. E. GAWTRY.—Mr. Harrison E. Gawtry, president of the New York Consolidated Gas Company, has resigned. According to an officer of the company, Mr. Gawtry's resignation was sent in early in the year, after he had left on a trip to California for his health. It is said that Mr. George F. Baker, president of the First National Bank, may nominally assume the position.

MR. E. T. PIETZCKER, who has been attached to the western sales department of the Standard Underground Cable, with headquarters at Chicago for the past two years, has been appointed manager of the new sales office for the Southwest. This office is located at 521 Security Building, St. Louis. Mr. Pietzcker has had many years' experience in the wire and cable business, and his long residence in the South will enable him to greet many old friends in returning to that territory.

MR. W. E. HARRINGTON has resigned his position as general superintendent of the South Jersey division of the Public Service Corporation, with headquarters at Camden, to accept the office of vice-president and general manager of the New York-Philadelphia Company, which is operating an electric railway between New York and Philadelphia, by way of Trenton. Mr. Harrington is a graduate of the University of Pennsylvania, and has had a large experience in electric railways.

MR. FRED DE LAND.—At the recent annual meeting of the Kansas State Board of Agriculture, held at Topeka, Kan., Mr. Fred De Land, treasurer of the Federal Telephone Company, Fittsburg, Pa., delivered an address on the topic of "Eliminating Isolation and Distance from Farm Life." Mr. De Land rehearsed the developments which had been made in improving the condition of rural communities. He called attention to the remarkable advance made since the invention of a practical reaper, and suggested that the only other invention which had brought to rural communities the same advantages was the electric speaking telephone.

MR. C. J. H. WOODBURY, of the engineering department of the American Telephone & Telegraph Company at Boston, gave a lecture on "Electricity and the Fire Hazard" on the evening of February 10, before the Worcester Polytechnic Institute branch of the American Institute of Electrical Engineers. He pointed out the dangers arising from improper installation of equipment and emphasized the usefulness of electricity and particularly the telephone as a means of signalling fire alarms. The lecture was illustrated by a large number of stereopticon views and was attended by many engineers and electrical men prominent in Worcester and its vicinity.

PRESIDENT E. H. DAVIS, of the National Electric Light Association, has recently taken an active and conspicuous part in the municipal ownership campaign that has been centered around New York City. His vigorous and incisive letters to the press have attracted a great deal of attention and have undoubtedly done much to influence public opinion by setting forth the facts and arguments which support the contention that private enterprise is the best means of furnishing such utilities as gas, electric light, transportation, etc. The newspapers containing the communications by Mr. Davis have been in much demand, and his appearance in the controversy has given it a dignity and tone which would not otherwise have characterized it. The work of the association, through its president, has thus been highly beneficial to the industry for which the association stands in the eyes of the nation.

MR. WALTER FAIRCHILD has been placed in charge of the New York office of the National Electric Company, 135 Broadway, New York. He formerly represented the Bullock Electric Manufacturing Company in this city, and prior to that represented the Stanley Electric Company in New York. Mr. Fairchild is well known in electrical engineering and commercial circles in New York City, as well as throughout the State. He is a graduate of Lehigh, where he took a prominent part in athletics. Mr. Fairchild is an enthusiastic automobilist, and starts out on his new work with a large circle of friends. Mr. Robert S. Hopkins has been appointed New York City sales agent. He obtained his engineering experience with the Bullock Manufacturing Company, and while with them had charge of installing many of their alternating and direct current plants. Mr. J. Frank Perry has just been appointed sales engineer. His field of operation has been largely through New England, but he has been connected with important power installations in all parts of the world. Mr. Perry is at the present time in California representing the interests of the National Electric Company.

MR. HENRY E. VINEING, formerly electrical engineer of the fire alarm and telegraph branch of the New York Fire Department, has been appointed consulting engineer to the Department. Mr. Vineing has had a very extensive experience in the designing and construction of electrical plants in both hemispheres. In 1878 he was largely instrumental in the construction of the Jablochkoff plants in St. Petersburg, Russia, which were among the very first practical electric lighting systems built in Europe. During 1883 he designed the Remington lighting system. He built the original lighting plant at Augusta, Ga., and also constructed the Detroit Accumulator plant. From 1893 to 1897 Mr. Vineing acted as electrical engineer in the Brooklyn Navy Yard. He was in Cuba from 1898 to 1902, where he designed and constructed central stations at Senado, Rosario, Dos Hermanos and other towns located in the interior of the island. While electrical engineer of the fire alarm and telegraph branch of the New York Fire Department, he designed and built the non-combusitble fire alarm switchboard, Borough of Richmond, New Brighton, Staten Island, which was described in Electrical World and Engineer, March 5, 1904.

MR. ARTHUR B. LISLE, assistant general manager of the Narragansett Electric Lighting Company, and one of the most valued officials of the corporation, has resigned his position there, to take effect March 31, and will thereafter continue his active business career as a member of the firm of D. A. Peirce & Company, bankers, of Providence, R. I. Aside from his position

with the Narragansett Company Mr. Lisle has been conspicuously identified with other large interests of a semi-public nature. He was treasurer of the East Providence Water Company for a number of years, and was responsible in a large measure for the rapid growth of the enterprise during his tenure of office. About a year ago Mr. Lisle purchased for private interests a majority of the stock of the Putnam Light & Power Company, which controls the gas and electric properties in Putnam, Conn. He extended the sphere of operations of that company to include Pomfret and Thompson, and with the development of the water power at Mechanicsville the success of the venture is assured. His decision to retire as assistant general manager of the Narragansett Company, although recently re-elected, is the result of the growth of outside interests to such an extent as to require a good deal of his time, which he will be in a position to devote more freely in connection with his duties as a member of the firm of D. A. Peirce & Company.

EARLY HISTORY OF THE TELEGRAPH.—The late Gen. Lew Wallace, author of "Ben Hur," recently related an interesting episode in the early history of the telegraph. The father of Mr. Wallace was a Member of Congress at the time Morse was endeavoring to procure an appropriation to build an experimental line between Washington and Baltimore, and was one of the committee to which the question of the appropriation was referred. When the committee met, the Congressman was watching the experiment of telegraphing from the House to the Senate. Wires had been stretched, and the inventors were operating the instruments. Mr. Wallace saw them work; he sent messages and received replies. Then he went to his committee room and found the committee in session. They had just voted on the appropriation and their vote was a tie. He cast his vote in its favor, and this caused the appropriation to go through. "Strange to say, that vote lost my father his seat in Congress," continued Gen. Wallace. "Thirty thousand dollars was then a big sum, and this vote became one of the issues of the next Congressional campaign. Father was charged with wasting the people's money, and his opponent ridiculed him on the stump by referring to his 'magnetico, electrico, telegraphic appropriation which no one could explain.' I even asked father to explain it, but at that time he could not do so, although he said it would be of great benefit to the country. The people thought differently, and the result was his defeat!"

Trade Publications.

THE NORTHERN ELECTRIC MANUFACTURING COMPANY, Madison, Wis., has marketed a compact, self-contained type of electric forge blower Leaflet No. 145, as issued by the company, shows the general type and sizes supplied.

POPE MANUFACTURING COMPANY, Hartford, Conn., in a well illustrated catalogue describes in detail the mechanism of its Pope Hartford Model D automobile. This machine is driven by a 16-hp, two-cylinder, water-cooled gasoline engine. The transmission gear is exceptionally strong and is well protected from dust. For the ignition, common dry batteries are used on account of the ease with which they can be obtained and because their renewal can be made at a minimum of expense. In appearance the car suggests power and speed.

W. R. OSTRANDER & COMPANY, 22 Dey St., New York, have issued an illustrated catalogue of 572 pages, devoted to speaking tube hardware, electric bells and batteries, electric light material, telephone and telegraph instruments and general electric supplies. This catalogue in itself is exceptionally complete and may well serve as a reference book of electrical supplies. The company states, however, that it does not cover all the lines of material carried in stock, and that it is in position to furnish at short notice, and at market prices, anything in the electrical market.

EXIDE BATTERY.—Price list X, issued by the Electric Storage Battery Company, Alleghany Ave. and 19th St., Philadelphia, Pa., deals with batteries for electric vehicles and gives a complete list of parts of type PV and MV Exide cells, and a description of the Exide sparking battery. This company has acquired all the patents and patent rights concerning the manufacture of electric storage batteries heretofore owned or controlled by twelve different companies, both in this country and abroad, and thereby controlls the production of these various important types as heretofore developed.

THE NERNST LAMP COMPANY, Pittsburg, Pa., proposes to issue regularly each month a bulletin to be devoted exclusively to the central station lighting companies, and which will be somewhat similar in character to the bulletins issued by the various Edison and other lighting companies. The columns will be opened to the customers of the company in order that they may ask questions of their fellow managers regarding their methods of securing business by means of the Nernst lamp. The series began with the issue for January, 1905, so that up to the present time two bulletins have appeared.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has recently issued bulletin No. 1061, describing the new multiphase induction integrating Type K wattmeter, which is made on the same general principles as the well-known single-phase Type K. It has, however, the advantage of higher torque, and gives complete registration of all energy in a multiphase circuit on a single dial place. The case is made of aluminum, is put on and removed from the front, and is sealed on top by a single sealing screw. For switchboard use, multiphase Type K wattmeters are made with cylindrical glass cases with no provision for sealing.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., is initiating a campaign of education by sending forth a miniature pamphlet entitled "Wattmeters and How to Read Them." This pamphlet is intended for use by the consumer of electricity, careful instructions being given as to the significance of the various dials on a recording watt-hour meter, and a few hints as to the theory of the operation of the driving motor being included. The pamphlet should prove effective in dispelling the doubt and mystery possessed by the average consumer concerning the supposedly too-energetic lieutenant of the electricity company on his premises.

TROJAN FAN MOTORS.—The results of proper regard for details of manufacture characterize the fan motors to be placed on the market for the season of 1905 by the Emerson Electric Mfg. Company, St. Louis, as described in bulletin No. 2895. The desk fans are provided with substantial and compact self-oiling bearings which have been designed with great care. The motors are of the induction type, using a squirrel-cage armature without insulated wires or commutator. The ceiling fans are so wired that two or four incandescent lamps may readily be added at any time, and, whether equipped with the lamps or not, the fan has a handsome appearance. In winter, with the fan blades removed, the equipment is still attractive and serviceable as a chandelier.

THE KAISLING PROTECTOR, manufactured by the American Electric Fuse Company of Chicago, is the subject of a very attractive book just issued from the press. The publication contains profuse illustrations and descriptions of the Kaisling apparatus, and typographically is one of the most artistic catalogues of the year. The American Electric Fuse Company is an aggressive, hardworking and persistent seeker for business, and during 1905 it expects to increase very largely its protector business. The Kaisling protector is highly commended by both engineers and operators, and is said to be very successful wherever installed. It also possesses the very desirable merit of being absolutely free from any present patent litigation, the American Electric Fuse Company having, it is stated, been successful in all its recent patent suits involving protectors.

THORDARSON EXPERIMENTAL APPARATUS.—Visitors to the Electricity Building at the recent World's Fair were entertained and instructed by a remarkable series of experiments performed with simple direct and alternating current magnets. The experimenter, Mr. C. H. Thordarson, of Chicago, has recently issued an illustrated pamphlet describing the various experiments and calling attention to the apparatus employed. Characteristic features of the equipment are simplicity, strength and flexibility, a very few well-constructed parts being sufficient for about 600 experiments. The pamphlet contains among a number of photographs of high voltage arcs, one showing the discharge from a million-volt, 100-kw transformer, the length of the arc being 100 inches. It is stated that transformers for testing insulation will be built to order for any potential up to 1,000,000 volts and for any capacity up to 200 kilowatts.

ACHESON GRAPHITE PAINT.—Electricity is entering into the manufacture of paint in a novel and most interesting way through the efforts of the International Acheson Graphite Company. In order to form an adequate protection to iron against corrosion, there is required a combination of an oil having the greatest impenetrability to moisture and corrosive agents, a finely powdered and amorphous pigment, absolutely inert and unaffected by any conditions of exposure, and a drier in the proper proportions to cause a firm bonding of the pigment. Linseed oil and either red lead or manganese borate form ideal oil and drier constituents while artificial graphite has been found to be perfectly adapted for use as a uniform inert pigment. The Acheson method for producing graphite in the electric furnace is too well known to need comment. The Atcheson graphite paint has been selected for use exclusively upon the new plants of the National Tube Works at McKeesport and Lorain, after an exhaustive series of tests extending over a period of eighteen months. The advantageous properties of this paint are attractively presented in a booklet issued by the International Acheson Graphite Company, Niagara Falls, N. Y.

NATIONAL BATTERY COMPANY, of 368-382 Massachusetts Ave., Buffalo, N. Y., in a catalogue recently issued, describes electric storage batteries with especial reference to the "Unit Accumulator," which has been built for high charge and discharge rates. The positive plate is of the Planté and the negative plate of the Faure type. In the construction of the positive, no attempt has been made to prevent the natural growth of the active material portions, but ample room has been provided for it. The active portions are hung in a rigid lead frame, with sufficient space at the bottom and at the two sides of each unit to allow for expansion without in the least straining or distorting the supporting frame. The high back pressure during charging, as found with the ordinary Planté negative, does not occur with the National pasted type of plate. The National Battery Company is prepared to make new installations complete with all necessary electrical machinery, or to make renewals of batteries already installed. This company has recently issued a separate catalogue dealing with the pasted type of battery which has been found to be best adapted for electric vehicles. The positive grid is of the staggered form, and has a large conducting surface which reduces the internal resistance to a minimum and gives a sustained high voltage during discharge. The positive grid is of the punched and clinched type, having the material on the two sides of the plate welded together. The automobile batteries are furnished with soft rubber bridges which very greatly reduce the jarring that the elements receive while the vehicle is running, and thus largely prevent the dislodging of active material from the plate.

News of the Trade.

CROCKER-WHEELER COMPANY, Ampere, N. J., has recently supplied a 35-hp motor for driving a Goss straightline, three-deck and color newspaper press for the Youngstown (Ohio) *Telegram*. The motor is of the variable speed type, being equipped with a Cutler-Hammer controller and circuit opening devices operated by push-buttons.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has brought forward a novel type of motor as a solution of the variable speed problem. Twin motors, each with a double armature winding, are mounted on a common bed-plate and arranged to drive a common gear. The variation of speed is obtained by series-paralleling the four component motors of the equipment. A recent application of this type of motor is found in the printing office of the Dayton (Ohio) *Journal*.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 14, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Atty's, 140 Nassau St., N. Y.]

782,254. TELEGRAPH RELAY; Joseph W. Larish, Bridgeport, Conn. App. filed Aug. 18, 1904. A combined telephone and telegraph system comprising a polarized relay and neutral relay responsive to increased currents only; a local circuit controlled by each of these relays and an induction coil the secondary of which is in circuit with the polarized relay and its primary in the line.

782,255. CONNECTION BOX; Ernest R. Le Manquais, New York, N. Y. App. filed Jan. 15, 1904. A knockdown box made up in sections, any number of which as required can be assembled to produce the box of a definite size.

782,285. SIGNAL LAMP; Howell W. Souder, Tamaqua, Pa. App. filed May 16, 1904. The lamp is enclosed in a hood or box having openings covered by reticulated screens, whereby an observer can ascertain definitely whether the light is burning in either day or night time.

782,310. OBTAINING OSCILLATORY OR RECIPROCATORY MOTION; Harry H. Young, Colchester, Eng. App. filed Dec. 12, 1902. It is contemplated to make use of a number of solenoids acted upon by a current which flows through them to actuate a movable arm so as to cause it to oscillate, the said arm operating a contact device which controls the flow of current to the solenoid.

782,311. ELECTRIC DISPLAY APPARATUS; Edmund L. Zalinski, New York, N. Y. App. filed Sept. 6, 1904. The base of the sign comprises a number of tracks through which the current flows; the sockets for the lamps slide along these tracks to any desired position for the formation of letters.

782,323. TELEPHONE SYSTEM; Daniel W. Campbell, La Crosse, Wis. App. filed June 21, 1904.

782,312. ELECTRIC TRACTION APPARATUS; Alfred Zehden, Charlottenburg, Germany. App. filed June 21, 1902. The rotary field idea is used here for traction purposes by arranging the poles as if they were opened out in a line of indefinite length.

782,340. MEANS FOR REGULATION OF DYNAMO-ELECTRIC MACHINES; Alfred S. Hubbard, Greenwich, Conn. App. filed Feb. 20, 1902. An inductive device, responding to sudden changes in the dynamo or motor circuit, influences the field magnet to overcome corresponding changes in the voltage or speed.

782,366. SUPPORTING BRACKET FOR MESSENGER WIRES; Harold D. Stroud, Chicago, Ill. App. filed Oct. 5, 1903. A bracket having an under cut groove receiving the end of a clamping jaw, the opposite end of which is held by a single bolt, the conductor being clamped between the jaw and bracket.

rear end signals showing when the current is on or off.

782,455. CAR SIGNAL SYSTEM; William Lintern, West Park, O. App. filed Nov. 28, 1904. A system of circuits involving the idea disclosed in the preceding patent.

782,456. SYSTEM OF ELECTRICAL DISTRIBUTION AND CONTROL; Edward Lyndon, New York, N. Y. App. filed March 24, 1904. The object of this invention is to provide for varying the number of cells in circuit without the use of an end cell switch and without a separate conductor from each end cell to a point external to the battery.

782,463. CONDUCTOR FOR THE ARMATURE-WINDINGS OF DYNAMO-ELECTRIC MACHINES; Charles Algernon Parsons, Newcastle-Upon-Tyne, England. App. filed Oct. 1, 1902. (See Current News and Notes).

782,502. ATTACHMENT FOR EXPLOSIVE ENGINES; William B. Hayden, New York, N. Y. App. filed Feb. 15, 1904. A yielding coupling device between the engine and ignition generator for operating the latter when the engine is operated and means for storing energy in the coupling device when the engine is supplied so as to operate the generator in advance of the operation of the engine.

782,524. UNIVERSAL FIXTURE TAP AND RECEPTACLE HOLDER; Charles S. Ryerson, New York, N. Y. App. filed May 25, 1904. Details of a plug intended to connect with a circuit under a canopy fixture.

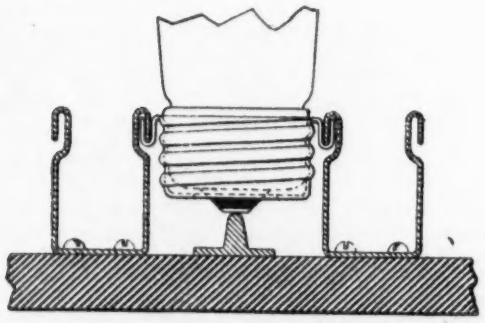
782,525. ELECTRICAL WATER HEATER; Milton H. Shoenberg, San Francisco, Cal. App. filed June 30, 1904. A tank through which water flows contains a heating resistance, the circuit of which is controlled by the same handle that controls the flow of the liquid.

782,550. ELECTRIC SYSTEM; Horace Dowie, Brooklyn, N. Y. App. filed April 19, 1904. An alternating direct electrical machine and equipments connected with main lines comprising direct circuits and alternating circuits, a storage battery connected to the direct circuits, a load circuit and automatic means comprising a controlled switch connected to the alternating circuit to throw the load circuit into connection with the direct circuit or with the alternating circuit.

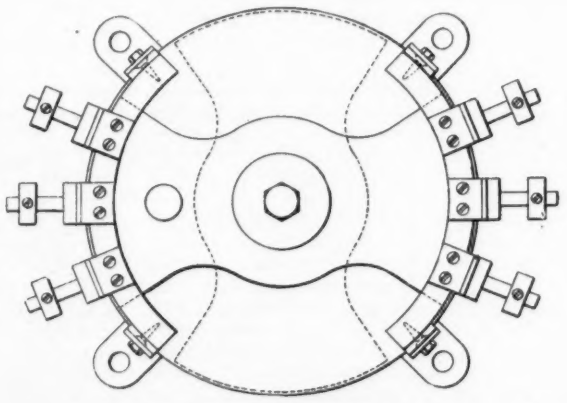
782,551. IGNITION DEVICE FOR CENTRAL DRAFT LAMPS; Charles E. Gervais, New York, N. Y. App. filed May 29, 1903. A platinum coil located at the top of an ordinary oil lamp, the battery being in the base of the lamp.

782,576. CONDUIT FOR ELECTRIC WIRES; Robert W. Lyle, New York, N. Y. App. filed May 2, 1903. A conduit section having an enlarged socket end and external bearing ribs flush with such end.

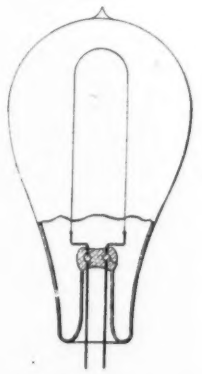
782,589. TROLLEY; Benjamin Williams, Columbus, O. App. filed June 17, 1904. Two poles provided at the center of the car, one for operation in one direction, and the other for the reverse direction, one being thrown into operative position when the other is thrown out.



782,311.—Electric Display Apparatus.



782,731.—Magnetic Controlling Mechanism.



782,749.—Incandescent Electric Lamp.

782,367. CABLE TERMINAL; Charles R. Sturdevant, Mansfield, O. App. filed March 25, 1904. Details of construction of an insulating bushing surrounding the end of the cable and of take-off clips for branch conductors.

782,376. FOUR-PARTY-LINE TELEPHONE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed Nov. 14, 1903.

782,382. TELEPHONE-EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed May 20, 1903.

782,386. FRAUD DETECTOR FOR ELECTRIC METERS; Walace W. Fuller, Charleston, S. C. App. filed May 20, 1904. The operation of the device depends upon a balanced current with the effect that any attempt to tamper with the meter disturbs the balance and causes the device to release a switch which opens the main circuit, thus exposing the attempted fraud and cutting off the supply.

782,391. ELECTRIC CABLE; Albert P. Hanson, Charlottenburg, Germany. App. filed March 19, 1904. Openings in the insulation are provided at intervals to permit of branches being taken off at such points.

782,400. APPARATUS FOR HYGIENIC AND THERAPEUTICAL PURPOSES; Jean M. A. Lecomme, New York, N. Y. App. filed Sept. 3, 1903. Details of an apparatus constructed and arranged to transform, vary, modify or change the atmosphere in such manner that its action upon the human system through breathing will be beneficial to health, etc.

782,405. TROLLEY; John Martland, Detroit, Mich. App. filed Jan. 2, 1903. A bail-shaped trolley pole mounted at center of the car and carrying a tilting harp having two trolley wheels and springs arranged each side of the harp permitting it to tilt when encountering inaccuracies in the wire.

782,417. CEILING AND WALL BOX; James T. Robb, Flatbush, N. Y. App. filed June 1, 1903. A sheet metal box in which the sides and top have inter-connecting lugs and depressions integrally formed, affording cheap and quick construction.

782,419. INTERCOMMUNICATING TELEPHONE-SWITCH; William H. Rose, Catonsville, Md. App. filed Nov. 21, 1904.

782,422. RECEIVING APPARATUS; Harry Shoemaker, Jersey City, N. J. App. filed Sept. 1, 1904. A complete set of apparatus for wireless telegraphy in which the parts can be quickly replaced by others whenever injury to them occurs.

782,450. ELECTRIC CONTROLLER; Hans Von Kramer, Bath, England. App. filed Jan. 21, 1904. The contacts with the controller are so arranged that preliminarily to breaking a circuit fractional resistances are cut in, and after the circuit is finally broken, are cut out.

782,453. THERMOSTAT; John I. Linler, Aiken, S. C. App. filed Feb. 13, 1904. Details.

782,454. CAR ON TRAIN SIGNAL; William Lintern, West Park, O. App. filed Aug. 4, 1904. Contacts upon the controller are provided to operate

782,593. MECHANISM FOR OPERATING ELECTRIC MOTORS AND CONTROLLING THE SPEED OF DEVICES ACTUATED THEREBY; Otto C. Britsch, Maspeth, N. Y. App. filed May 16, 1904. A foot pedal is arranged to simultaneously actuate a clutch and a motor switch.

782,645. RAIL JOINT; Ora M. Deemer, Gilmore, Neb. App. filed April 19, 1902. Details of an insulating joint.

782,652. INSULATED RAIL JOINT; George L. Hall, New York, N. Y. App. filed Jan. 9, 1904. Details of an insulating joint.

782,676. ARRANGEMENT FOR SECURING WIRES ON INSULATORS; Johann Macek, St. Polten, Austria-Hungary. App. filed March 19, 1904. A binding wire forming a clamp is permanently fixed to an insulating knob and is adapted to receive any size of conductor and to clamp it firmly to the insulator.

782,731. MAGNETIC CONTROLLING MECHANISM; Arthur C. Eastwood, Cleveland, O. App. filed Aug. 27, 1904. Control contacts are arranged around a single magnetic coil whose magnetic circuit is partially formed by a rotary armature which is moved from one position to another to successively close the various contacts by magnetic attraction.

782,732. CONTROLLER FOR ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, O. App. filed Sept. 14, 1904. A construction by means of which a portion of the field resistance with its corresponding contacts may be used for speed variations in connection with two voltages that may be applied to the armature and at the same time providing means whereby the controller may be readily adapted to various changes of speed control.

782,749. INCANDESCENT ELECTRIC LAMP; John H. Guest, Brooklyn, N. Y. App. filed May 14, 1904. To avoid the use of platinum leading-in wires, wires of copper or other sheet metal are used and shaped with a kink which compensates for the expansion or contraction of the wire.

782,751. AUTOMATIC ELECTRIC RAILWAY SIGNAL; William S. Jackson, Hoboken, N. J. App. filed Jan. 9, 1904. A part of each signal controlling device comprises two magnets each designed for the operation of a plunger that is lifted with sufficient force to raise a rolling weight, the latter being adapted to raise the semaphore and hold it in a display position; when the weight is removed from the semaphore the latter drops by gravity to a safety position.

782,786. TROLLEY POLE CONTROLLER; Joseph P. Magnet, Los Angeles, Cal. App. filed July 11, 1904. An automatic control for the trolley pole.

782,787. JAIL DOOR AND GRATING; Israel Maloch, Wyandotte, Mich. App. filed Dec. 16, 1903. A composite structure of tubes and rods with insulation properly inserted to close an alarm circuit whenever the bars are tampered with.

782,796. TROLLEY SWITCH; Alexander Palmros, Columbus, O. App. filed June 6, 1901. A switch for a side running trolley.